 MARTIN MARIETTA

‹RTIN MARIETTA ENERGY SYSTEMS, INC. POST OFFICE BOX 2009
OAK RIDGE, TENNESSEE 37831

April 23, 1996

Ventilation

Ms. S. M. Flack
ChemRisk
2870 Kalmia Avenue
Suite 308
Boulder, Colorado 80301

Dear Ms. Flack:

Document Requested by ChemRisk - Health Studies Agreement

Enclosed are documents requested by E. Choat, a consultant to ChemRisk. These documents have not previously been submitted for review and approval for public release. The Y-12 Plant Classification and Technical Information Offices have reviewed these documents and determined that they contain privileged information as discussed in the Department of Energy (DOE) Order DP 5650.1, "Identification of Defense Programs Official Use Only (OUO) Information." Based on that opinion, these documents are being issued to you as OUO to signify that they contain unclassified sensitive but otherwise uncontrolled information which may be exempt from public release under the Freedom of Information Act. Also enclosed is a copy of DP 5650.1, "Identification of Defense Programs Official Use Only Information," to assist you in the handling of these documents.

We also remind you that even though these lists identify the drawings as being unclassified (U), transmittal of any of the drawings for use in your program will still require review and release by our Classification and Technical Information Offices.

Y/TS-1492 "Drawing List of Buildings 9201-4 and 9204-4 (HVAC Systems by Catalytic)," Lockheed Martin Energy Systems, Y-12 Plant (April 12, 1996).

Y/TS-1495 "HVAC Drawings of Building 9201-5 (Computer Printout)," Lockheed Martin Energy Systems, Y-12 Plant (April 17, 1996).

Documents transmitted contain Official Use Only Information. When separated from enclosures, this document does not contain Official Use Only Information.

OFFICIAL USE ONLY

If you have any questions, please contact L. L. McCauley at (423) 574-7593 or S. W. Wiley at (423) 576-0263.

Very truly yours,

L L McCauley

For R. M. Keyser, Director
Health, Safety, Environment,
and Accountability Organization

RMK:djl

Enclosure: As Stated

c/enc: S. W. Wiley (RC)

c: T. R. Butz
C. D. Goins, Jr
F. P. Gustavson
T. W. Joseph, DOE-ORO
R. M. Keyser
L. L. McCauley
S. D. Morris, DOE-ORO
R. J. Spence, DOE-ORO

OFFICIAL USE ONLY

FACSIMILE COVER SHEET

TO:		FROM:	
Susan Flack		E. E. Choat	
Company: SFI 1544 North Street Boulder, CO 80304		Company: Environmental Engineering Consultants 672 Robertsville Road Oak Ridge, TN 37830	
Phone:	303 449 8471	Phone:	423 483 6062
FAX:	303 939 8318	FAX:	423 482 2605
e-mail: Echoat@Aol.com		Web Page: http://www.animedia.com/echoat/	
Date: October 20, 1999		Pages including this cover page -- 1	

Message:

I have not found the drawing lists on 9201-4, 9201-5 nor 9204-4 that Steve Wiley is looking for and, I am not certain that I have ever had them in my possession. I do recall looking at drawing lists in Steve's office to identify documents that appeared to be useful. He would then have copies made for my use.

Sorry to be unhelpful.

5.4 COLEX PROCESS DESIGN FEATURES RELATED TO EMPLOYEE HEALTH

5.4.1 Drains, Dams, and Sumps

Process areas within these buildings were designed to contain and collect process losses through leaks and spills in a floor drain system that fed into a series of two collection tanks within each process building. The liquid overflow from the first collection tank fed a second collection tank in series. Mercury collected was routinely removed. Overflow from the second tank went into a sump with a weir outside and adjacent to the building. Overflow from this sump entered the storm sewer system. These systems contributed significantly to reduction of losses to the creek.

5.4.2 Ventilation Systems

In order to help maintain the air at safe air contamination levels, a ventilation exhaust system was used. The system consisted of high-speed fans that provided a ventilation rate of 2,836,000 ft^3/min. Both general and spot ventilation systems were provided.

5.5 STANDARD OPERATING PROCEDURES FOR COLEX START-UP

During the operation of the lithium isotope separation cascades at Y-12 during the 1950s and 1960s, many administrative rules and procedures were formulated and put into effect to try to minimize mercury vapor concentrations in the air and contact by the workers. Three procedures pertaining to mercury developed for Colex operations prior to start-up in 1955 are summarized below.

5.5.1 Procedure 1906 - General Operator Duties

Standard Procedure 1906, "General Operator Duties," indicated (Ref. 32) that operations in the Colex plants were continuous and certain responsibilities were thereby assigned to operating personnel. Of interest in this procedure is Item 3, "Keeping Working Conditions Healthful." The procedure pointed out that both the mercury and the lithium hydroxide used in the plant presented some hazard to health because of their toxic and caustic effects, respectively. Important rules and recommendations that applied to Colex areas and their auxiliary buildings were also outlined. Smoking was prohibited in certain process areas, and the carrying of cigarettes or tobacco in such areas was discouraged. Storing or eating food in process areas was not permitted. Before either eating or smoking, operating personnel were required to wash their hands. Safety shoes and company-issue clothing had to be worn in all process areas, and rubber gloves were required in certain other areas and when handling mercury or other process solutions. Operators were responsible for keeping floors and equipment in process areas clean, and particular emphasis was placed on cleaning up spills of any substance as soon as possible.

Change facilities with separate lockers for work and personal clothing were provided. Shower facilities were available.

5.5.2 Procedure 1859 - Heating and Ventilating System

Standard Procedure 1859 (Ref. 33), entitled "Operating Procedure for Alpha-4 Heating and Ventilating System," gives information on the nature of the process, the nature of materials handled in this building, and extensive ventilation requirements. Such a procedure helped to keep ventilation equipment functioning properly and to lower air contamination levels.

5.5.3 Procedure 1856 - Waste Disposal System

Standard Procedures 1856 (Ref. 34) was entitled "Operating Procedure for Alpha-4 Waste Disposal System." The waste disposal system was used to receive liquid plant waste and, when necessary, to neutralize material before sewering. The system consisted of a waste disposal sump, a system of separators and floor drain sumps for collecting floor wastes and separating the mercury, neutralizing agents, sumps, and sewers. Waste from operations flowed into the waste disposal sump where it was periodically neutralized and sewered. Waste from floor drains flowed into separators and then into tunnel sumps. From these sumps, it was pumped to the waste disposal sump for neutralization disposal. This procedure helped in reducing air contamination by providing instructions on operating the system whereby spilled or leaked mercury could be removed from the operating areas.

5.5.4 Other Procedures

In addition to the above, other procedures were issued that contained specific instructions pertaining to employee health. For example, Procedure 1450, "Operating Procedure for Alpha-4 Solvent Systems," Procedure 1600, "Operating Procedure for Alpha-4 Absorber Systems," and Procedure 1905, "Operating Procedure for Alpha-5 Solvent Systems," contained health-related instructions such as:

1. Clean solvent from floors immediately upon spillage.
2. Splashing must be avoided.
3. Rubber boots must be worn.
4. Keep water flowing across the surface of all solvent vessels.

5.6 THE 1955-TO-1956 PROGRAM TO CLEAN UP THE CASCADE AREAS

[redacted] 9201-5 cascades with all of their auxiliary equipment were placed in operation during the first three months of 1955 (Ref. 35). Every effort was made to start the first cascade at the earliest possible date in order to establish the stability of the

Steve W:

Hg furnace photo w/b mailed

9401-1 ~~[illegible]~~ torn down Jan 57 April → recycling facility

9401-2 old steam plant

Jan-May 57 demol'd

plating shop (1956)

'54-'56 built

Dec. running

Pb + tail smelter

HP storage facility

ceramic engines

air pollution cntl systems installed in '67 (bought '65)

Ernie steam plants

steamplant in Hg Files (Technical reports, 1st 2 drawers)

raw data

2 names - no phones address

ret'd '84

Joe L. Hart Lake City, TN

921 Grave Ave.

Charles Wilson Caryville TN

Rt 1 Box 132

call Ernie C.

Chet - drawings not any good

These are mod's - not original drawings

Davy doesn't have

1. specifically why not right drawings

2. availability

Paul Smith @ K-25 has "archived" data

576-4535

RP ?

1. can he get in to the front desk ?
2. that guy next door that has a clearance - work with us ?
3. PAI guys with clearances ?

drawing no.:

size CDE

MARTIN MARIETTA

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2009
OAK RIDGE, TENNESSEE 37831

March 21, 1996

Ms. S. M. Flack
ChemRisk
2870 Kalmia Avenue
Suite 308
Boulder, Colorado 80301

Dear Ms. Flack:

Document Requested by ChemRisk - Health Studies Agreement

Per your request, I have provided copies of 57 drawings you have selected from the document entitled *"Index of Building Master Plans for Buildings 81-10, 9204-4, 9201-4, and 9201-5 (Y/TS-1472)"* directly to E. Choat, a consultant to ChemRisk. These drawings have not previously been submitted for review and approval for public release. The Y-12 Plant Classification and Technical Information Offices have reviewed these drawings and determined that they do not contain classified or controlled information.

Y/TS-1485 "Master Plan Diagrams of Buildings 81-10, 9201-4, 9201-5, 9204-4, and 9204-5," Lockheed Martin Energy Systems, Y-12 Plant (March 13, 1996).

If you have any questions, please contact L. L. McCauley at (423) 574-7593 or S. W. Wiley at (423) 576-0263.

Very truly yours,

LL McCauley

for R. M. Keyser, Director
Health, Safety, Environment,
and Accountability Organization

PAUL SMITH
EDIS - INDEX SYSTEM
G-1535
K25 1007

RMK:djl

Enclosure: As Stated

c/enc: A. L. Rothrock, DOE-ORO
S. W. Wiley (RC)

9201-4
9201-5
9204-2

c: T. R. Butz
C. D. Goins, Jr
F. P. Gustavson
T. W. Joseph, DOE-ORO
R. M. Keyser
L. L. McCauley
S. D. Morris, DOE-ORO
R. J. Spence, DOE-ORO

Bldg. 9739

Phone Interview with **Mr. Gene Davy of Y-12 Engineering Records**

February 13, 1996

by Susan Flack

Contacts: Norma Conklin (6-7907) per Jack Lewis at Y-12
Gene Davy (4-1961) per RP at K-25

The Y-12 Engineering Drawing Department is the administrator of the EDIS database which is owned by the Y-12 Engineering Department. The EDIS database is not managed by the Y-12 Records Center Information Management System. The database contains Y-12 engineering drawings by drawing number and has a 26- or 72-character title block field that can be searched for keywords. Database entries for older drawings have only a 26-character title block, so abbreviations may be found in this field for older drawings. The drawing number series can be used to identify older drawings fairly close to the date on which they were drawn. The Master Plans for various Y-12 buildings can also be identified using this database.

A suggested approach is to do a building search for all drawings of that building, then narrow the list down to the type of drawing (e.g., HVAC for exhaust fan information). Paul Smith of CT&S can then produce a printout of the list of drawings, including the title block field and drawing series number, which can be reviewed by Y-12 and publicly released to Mr. Ernie Choat. Mr. Choat will review the printout and identify drawings to be pulled, copied ($1.25 per print) and publicly released for ChemRisk's use in the Dose Reconstruction study. Mr. Davy is willing to provide an estimate of the time required to do the database searches by conducting a preliminary search of the database, based on the table of parameters included in ChemRisk's letter to Steve Wiley dated 2-6-96.

called 2-28-96
dept on overhead now.
anyone with a acct. can do searches

TRM Comments on Letter to Steve: 1-26-96

(Chost?) do you have some engineer that could recognize and guess?
could you recommend an expert we could bring in?

what are the big holes in the bldg?

rpm rough est. of no. of cfm?

we've been told that you've got the some of best people in the world here at Y-12

we need a "reasonable enging. estimate" - can we go in the bldg. and eyeball it together?

I'll report to my bosses

to get him think we're (Y-12 Enging.) too dumb to do this

→ I'll write anything you want -
How can I best help you to help me?

If this just can't be done - then we'll go higher.

Ernest E. Chost
672 Robertsville
OR 37830

3 or 4 yrs. ~~ago~~

483-6062
482-2605 FAX

started '53 for Jimmy Little became Mgr., JL become consulting position

total cfm in Master Plans

Meeting w Ernie Choat
6-3-96

email sent 6-11 to tj

Mortality Study 1947-1990 - call Tim Joseph for paper copy

mPlan 85' only
(A-5) need plan roof drawing > big fans installed
fan speed - on fan? on special equipment drawing/sketch of fans?

2-3M
Sea Level 980' in ORR + height = roof grade

CFC = cert'd for constr (A/E → Contractor)
as built = modify drawing as it was actually built

mPlan good 2-3M
(A-4) need fan speeds (equipment list)

Master Plan w refs
Roof Plan
Equipment List

Q: modeling: How use summer vs. winter cfm

A-5 ran in summer mode always?
* vs. O.K. Kleinfelder said both

mPlan good 0.5M
(B-4)

(8-10) need e/thing on ventilation
have structure drawings (my photo)

(A-2) 1500 cfm off the 2 Trays
? off the columns in the corner

Steam plants: 1, 2 + 3

#3 had bigger boilers
#1, #2 stacks may be shorter

* send EC the text from Turner's report
#3 200' stack 250'
boilers - ops people? dead
induced draft fans

Steam Plants

	Old	New
	9401-1 9401-2	9401-3
Stack Height (feet)	100' (estimated) "a lot shorter than 9401-3"	190' (2 sources per EEC)
Load (lbs steam/hr)	?	? summer: 50-100K ~60K winter: 300K "Guesstimates"
Fuel Burned (seasonal change)	gas/coal ? (summer/winter ?)	
Temp of Emissions	300°F	

Notes:

1. induced air boilers (EEC has Wick Boiler info.)
2. need Load and Fuel to know flue gas composition.
3. what is Turner's reference for Hg content of coal?
   This report (an air monitoring report) and a 1989 RI/FS document incorrectly state 9401-3 stack height to be 100'.
4. as opposed to Hg process buildings (ambient T flue gas), steam plant flue gas would be ≈ 300°F.

amt. air to burn fuel

if 100K/hr LOAD, ~~then~~ and if

Nick's boiler
(he has info on)

this is
the coal
you have,

then this
is the effluent
is.

ref. for Hg in coal = ?
% Hg emitted all (thorough T)
40°F 300° ist ↓↓ hard
due to condensation

190' stack 940-3

~100' 9401-1
9402-2

H_2 + fuel → H_2O
SO_2
⇒ SO_4

flue gases

"induced air boilers"

Volume load (when burned gas vs. coal)
winter 600K(3) (lbs stm/hr) summer i.e. 50K 100K

2200 velocity ~~constant~~ constant
or diameter constant

75,355 ÷ 4 ÷ 301,420

A-5 59-62
9201-5

~~9201-49~~
~~-10~~
~~-11~~

72"
or
54"

$$\frac{\pi \times d^2}{4} = 75{,}355$$

$$75{,}355 \text{ cfm} = \frac{\overset{X}{2200 \text{ fpm}} \; 3.14 \; (\overset{4.5}{\cancel{54 \text{ in}}})^2}{4}$$

7 or 6'

fpm

$= \cancel{2200} \times 20.25 \times$

$$\frac{(75355 \times 4)}{3.14 \times \cancel{20.25}} = X$$
36

$= 4740$
2666

54" 4.5
72" (6)

$$\sqrt{\frac{75355 \times 4}{3.14 \times 2200}} = \sqrt{Y^2}$$

$6.6 = Y$

79.2 inches = Y

FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: **E. E. Choat** (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: ~~3/9/96~~ Pages including this cover page -- 2

Monthly Report

Name: E. E. Choat Month of June 1996

__Summary of Activities since your visit of 6/4__

1. Met with Steve Wiley on June 11 to review drawings and drawing lists.
   a. Found pretty good lists of 9401-1 and 9401-2.
   b. Nothing of any help on 9401-3. We need drawings made by the AE who was Burns and McDonnell. Steve has gone back to try to locate.
   c. Found Wickes Boiler submittal data on boilers, preheaters, & fans. Has good information on gas flows at various loads. I can't copy, but I did make some notes. These must be cleared yet before I can get in hand.
   d. Steve showed me a set of master plans on 9201-4 --- made in 1970 --- that I had requested. They have not been cleared for release yet. Since this plant was simply shut down when operations ended, I believe these drawings represent all HVAC systems as they existed during the life of the Colex program. I believe these drawings will correlate well with ventilation flow sheets of that time and ventilation study documents. I think it will be possible to locate all exhaust points with good accuracy.
      These drawings are very good quality, they are complete, and they are easy to read.
   e. I also looked at a roof plan on 9201-5 that may be helpful in identifying the location of all exhaust fans of Jim Little's report.
   f. Nothing of great help in 9204-4 nor 9201-2. I may have about all I'm going to find.

2. June 20, I talked with my boss -- J. C. Little. He's 84 years old now, lives in North Carolina and is in good health. Among other things, we talked about your study. He remembers it well, but is a bit fuzzy as to details – and who wouldn't be after 40 years.

3. I have started a report of each of these buildings.

Next Month's Activities

1. Correlate & document Master Plan Drawings with Ventilation Study Report.
2. Correlate & document 9201-5 drawings with exhaust fans of Little's Study.
3. Correlate & document 9204-4 drawings with Baumann report.
4. Complete reports on all buildings of Task 1.
5. Obtain drawings on Steam Plant & determine stack heights. Bob Schabot (a former steam plant supervisor) & I think that there are two stacks. One is about 200 feet high and the other is 208. We will see.

Needs:

1. Clarification of your needs for the steam plants- if any- other than stack heights.
   a. I believe that 9401-1 & 9401-2 have not burned any coal since the 50's. Are you still concerned about these?
   b. I believe that 9401-3 burns natural gas a substantial part of the year. When I was in plant, I think they burned gas during the summer and coal during the winter. Too, at one period, they may have used gas about 80% of the time.
   c. Would it be helpful to your study to establish the history of fuel burned?

2. I regret having used all of the hours. I think an additional 50 hours will be needed to complete.

E. E. Choat

E. E. Choat

FACSIMILE COVER SHEET

fan diameter
fan location
% cfm N, S, ...
append Table 3

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

new table says exactly what no's

From: **E. E. Choat** (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 7/20/96 Pages including this cover page -- 9

summer 2X winter

Comment:
This is to transmit the 1st draft of my final report for building 9201-4. Two things are noteworthy.

1. This data is based upon drawings that are essentially As-Built. I think that the building is still much as it was in 1956.

2. Ventilation systems in this building are about twice as big as 9201-5.

3. A report on 9201-5 follows shortly.

E. E. Choat

Ventilation Systems of Building 9201-4
as Existed in 1956

Building Data

- Building 9201-4 is a large process building. It's overall size is 542 feet x 312 feet. It has 3 floors and a total volume 9,471,300 ft^3. It has seven operating bays – East Crane Bay, West Crane Bay, 4 Control Bays, & 1 Service Bay.

- During the time of the Colex Production Plant, the two major steps of process operations were identified as "Cascades", & "Absorbers". Cascades occupied all three floors of the East & West Crane Bays. Absorbers were located on the third floor of all four Control Bays. All building areas were contaminated with Mercury except for the Service Area, & Motor Generator (MG) Set Areas.

For this study, a set of simplified building plans have been reconstructed for the purpose of describing characteristics of the building and to illustrate the ventilation systems that were installed in 1956. These plans are included in this report as:

Figure 1 – 1st Floor Plan
Figure 2 – 2nd Floor Plan
Figure 3 – 3rd Floor Plan
Figure 4 – Section A - A – Building 9201-4

These plans are intended to show the location of various building processes, the location of major exhaust systems, and to provide dimensional information on the structure.

Ventilation

- Initial design was done by an Architect Engineering Company – Catalytic Construction Company. In general, 100 % outside air was supplied from the basement and exhausted via the 3rd floor walls and roof. Construction of this design was completed in 1955 but did not provide sufficient ventilation to maintain acceptable contamination levels.

- These systems were then modified and upgraded in 1956 in an effort to reduce contamination levels. The design was done by Catalytic Construction Company. Because of an increased vaporization of Mercury as temperature increased, more ventilation was provided in summer than in winter. Consequently, design documents and this report often refer to both.

Table 1 is a summarization of the findings of this study regarding the "Winter" Ventilation design for 9201-4. Recorded here are:

1. Identities of all process areas of the Colex Production Plant
2. Location of all process areas within the building. For example - Cascades 9 & 10 occupied all three floors between column lines 4 and 8.
3. Room volume of all process compartments
4. Fresh air supplied to each compartment
5. Air transferred between floors
6. Total Room Exhaust – it's the sum of air supplied and air transferred from another floor.
7. Changes per hour – It's a commonly used term to describe ventilation rates. Mathematically, it is equal to cfm x 60 – or cubic feet per hour – divided by the room volume. For this design, the fresh air volumes were used for calculations.

8. ~~7~~. Contaminated exhaust from the building – it's the air volume exhausted directly to outside. In this design, this air stream was sometimes exhausted via a duct system to the roof. In other instances is was exhausted via propeller fans mounted in the wall at the floor elevation.

It should be noted that the ventilation systems for the Motor Generator (MG) Sets are not included in this table as these areas are not considered to be contaminated. Too, air exhausted from the Maintenance and Service areas are not included in the total Contaminated Exhaust from the Building.
~~Contaminated Exhaust from the Building.~~
~~[illegible]~~
~~exhausted from the Maintenance and Service areas are not included in the total~~
~~Contaminated Exhaust from the Building.~~

Table 1
Winter Ventilation Design for 9201-4

								Contaminated
				Fresh Air	Air From	Room	Chgs.	Exh from
			Room	Supply	Floor Below	Exhaust	per	Building
Col	System	Floor	Volume	cfm	cfm	Cfm	Hour	cfm
4-8	Cascade 9 & 10	1	661,000	270510	0	270510	24.6	52000
4-8		2	402,500	181400	218510	399910	27.0	48000
4-8		3	1,209,000	275000	351910	626910	13.6	626910
						0		0
1-4	Chem.Rec., Feed Prep	1	297,000	93500	0	93500	18.9	93500
1-4	Hang Garden & Inj	2	248,500	129990	0	129990	31.4	129990
1-4	Absorber No. 10	3	311,000	151810	0	151810	29.3	151810
						0		0
8-11	General Stores	1	297,000	27000	0	27000	5.5	5110
8-11	Hang gardens &	2	246,500	34410	21890	56300	8.3	56300
8-11	Absorber No. 9	3	374,000	151810	0	151810	24.4	151810
						0		0
11-19	Maintenance	1	842,000	80000	0	80000	5.7	
11-19	Service	2	561,500	77800	0	77800	8.3	
						0		0
19-22	General Stores	1	297,000	27000	0	27000	5.5	940
19-22	Hang G. & Inj. #9	2	219,800	34410	26060	60470	9.4	60470
19-22	Absorbor # 8	3	374,000	151810	0	151810	24.4	151810
						0		0
22-26	Cascade 7 & 8	1	661,000	270510	0	270510	24.6	52000
22-26		2	402,500	181400	218510	399910	27.0	48000
22-26		3	1,209,000	275000	351910	626910	13.6	626910
						0		0
26 -29	Evaporator	1	297,000	38010	0	38010	7.7	38010
26-29	Hang G. & Inject 7	2	248,000	32000	0	32000	7.7	32000
26-29	Absorber No 7	3	311,000	151810	0	151810	29.3	151810
			9471300	2635180	1188790		16.7	2477380

Table 2 is a summarization of the ventilation design for "Summer" operation.

Table 2
Summer Ventilation Design for 9201-4

Col	System	Floor	Room Volume	Fresh Air Supply cfm	Air From Floor Below cfm	Room Exhaust Cfm	Chgs. per Hour	Exh from Building cfm
4-8	Cascade 9 & 10	1	661,000	297560	0	297560	27.0	48000
4-8	Cascade 9 & 10	2	402,500	199540	249560	449100	29.7	48000
4-8	Cascade 9 & 10	3	1,209,000	591775	401100	992875	29.4	992875
						0		0
1-4	Chem.Rec., Feed Prep	1	297,000	154350	0	154350	31.2	154350
1-4	Hang Garden & Inj	2	248,500	189990	0	189990	45.9	189990
1-4	Absorber No. 10	3	311,000	478210	0	478210	92.3	478210
						0		0
8-11	General Stores	1	297,000	29700	0	29700	6.0	5820
8-11	Hang gardens &	2	248,500	37850	24080	61930	9.1	61930
8-11	Absorber No. 9	3	374,000	478210	0	478210	76.7	478210
						0		0
11-19	Maintenance	1	842,000	80000	0	80000	5.7	
11-19	Service	2	561,500	77800	0	77800	8.3	
						0		0
19-22	General Stores	1	297,000	29700	0	29700	6.0	1040
19-22	Hang G. & Injection #9	2	219,800	37850	28660	66510	10.3	66510
19-22	Absorber # 8	3	374,000	478210	0	478210	76.7	478210
						0		0
22-26	Cascade 7 & 8	1	661,000	297560	0	297560	27.0	48000
22-26	Cascade 7 & 8	2	402,500	199540	249560	449100	29.7	48000
22-26	Cascade 7 & 8	3	1,209,000	591775	401100	992875	29.4	992875
						0		0
26-29	Evaporator	1	297,000	97810	0	97810	19.8	97810
26-29	Hang G. & Inject 7	2	248,000	35200	0	35200	8.5	35200
26-29	Absorber No 7	3	311,000	478210	0	478210	92.3	478210
			9471300	4860840	1354060		30.8	4703040

Previous reports of Mercury loss to the atmosphere via the building exhaust systems have been based upon the assumption that ventilation systems of 9201-4 were essentially the same as 9201-5. Since this study has indicated a considerable difference in contaminated air exhausted, a new estimate has been made for Mercury loss to the atmosphere for the period of the 2nd quarter of 1955 through the 1st quarter of 1958. The results of these calculations are exhibited in Table 3. Assumptions were:

1. Winter ventilation rates apply for the 1st & 4th quarters.
2. Summer ventilation rates apply for the 2nd & 3rd. quarters.
3. Mercury concentrations were as reported in "Wilcox", page 111.

OAK RIDGE HEALTH STUDIES

OAK RIDGE DOSE RECONSTRUCTION

INITIAL TASK 2 PROGRESS REPORT
INVESTIGATION OF MERCURY RELEASES FROM LITHIUM ENRICHMENT

SEPTEMBER 1995

Table 3
Calculation of Pounds of Mercury per Quarter Exhausted to Atmosphere from 9201-4

Year		Exhaust		Conc.	Effluent			
1955	Quarter	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day	lbs/qtr
	2	2050740	83630818	0.1	8363082	8363.1	18.44	1659
	3	2050740	83630818	0.25	2.1E+07	20907.7	46.09	4148
	4	1446429	58986532	0.25	1.5E+07	14746.6	32.51	2926
1956	1	1446429	58986532	0.12	7078384	7078.4	15.60	1404
	2	4703040	191793734	0.05	9589687	9589.7	21.14	1903
	3	4703040	191793734	0.05	9589687	9589.7	21.14	1903
	4	2477380	101029538	0.04	4041182	4041.2	8.91	802
1957	1	2477380	101029538	0.04	4041182	4041.2	8.91	802
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401
1958	1	2477380	101029538	0.02	2020591	2020.6	4.45	401

complete to 1962 (4Q)

Note: Comment on p. 111 of Hg T-Force Rpt.

Observations

1. Contrary to assumptions of previous studies, the ventilation systems for 9201-4 are not the same as 9201-5. From this study, the total contaminated air exhausted from these buildings was:

	Winter		Summer	
	Cfm	Air Changes	Cfm	Air Changes
9201-5	1684410	10.7	2357755	15.9
9201-4	2477380	16.7	4703040	30.8

2. Mercury lost to the atmosphere appears to be much higher than that reported previously.

3. As observed from the following table, contaminated air exhausted is predominately from the third floor and roof, i.e. about 90%. % T/N % T/S % Roof (E+W)

	Winter	Summer
1st Floor	2.6 %	11.6 %
2nd Floor	14.4 %	0 %
3rd Floor	50 %	60.7 %
Roof	33 %	28.1 %

References:

1. General Ventilation Study – Bldg. 9201-4 – design notes
2. Building 9201-4 – 4 Tray Rooms – design sketch
3. Proposed Cascade Ventilation – design sketch
4. Proposed Absorber Ventilation – design sketch
5. McAlister, Don, General Ventilation- Bldg. 9201-4, 8/15/55 – design sketch
6. EM-708 through EM-729, Master Plan Drawings completed 1970. These are believed to represent As-Built conditions for the Colex Production Project. Since this building has not been modified since shut-down, these drawings should be an accurate record of 9201-4 ventilation systems of 1996 as well.
7. Catalytic Construction Company's Ventilation Flow Sheets
8. Catalytic Construction Company's Construction Drawings

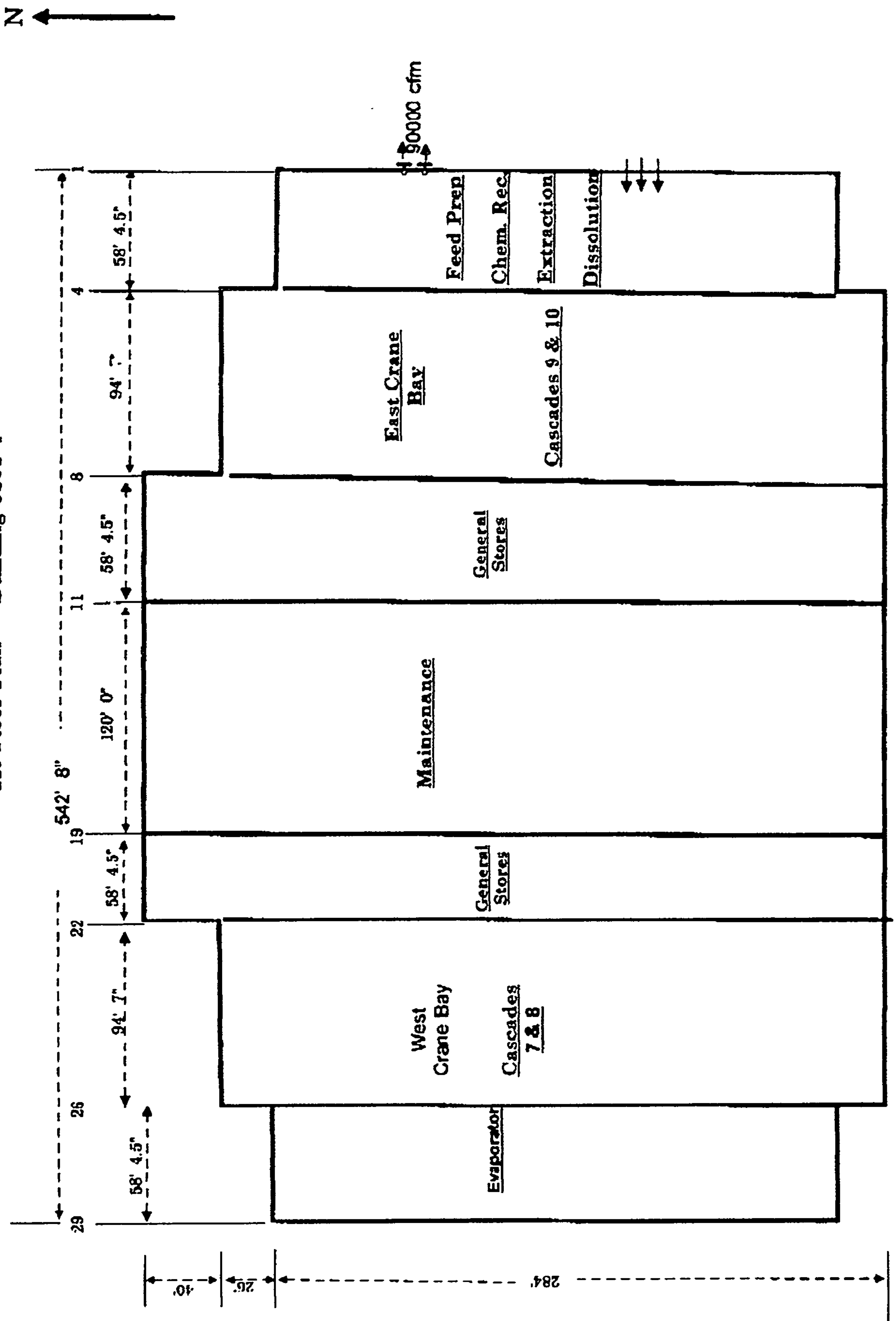


Figure 1
"1st Floor Plan" -- Building 9201-4

Figure 2
"2nd Floor Plan" -- Building 9201-4

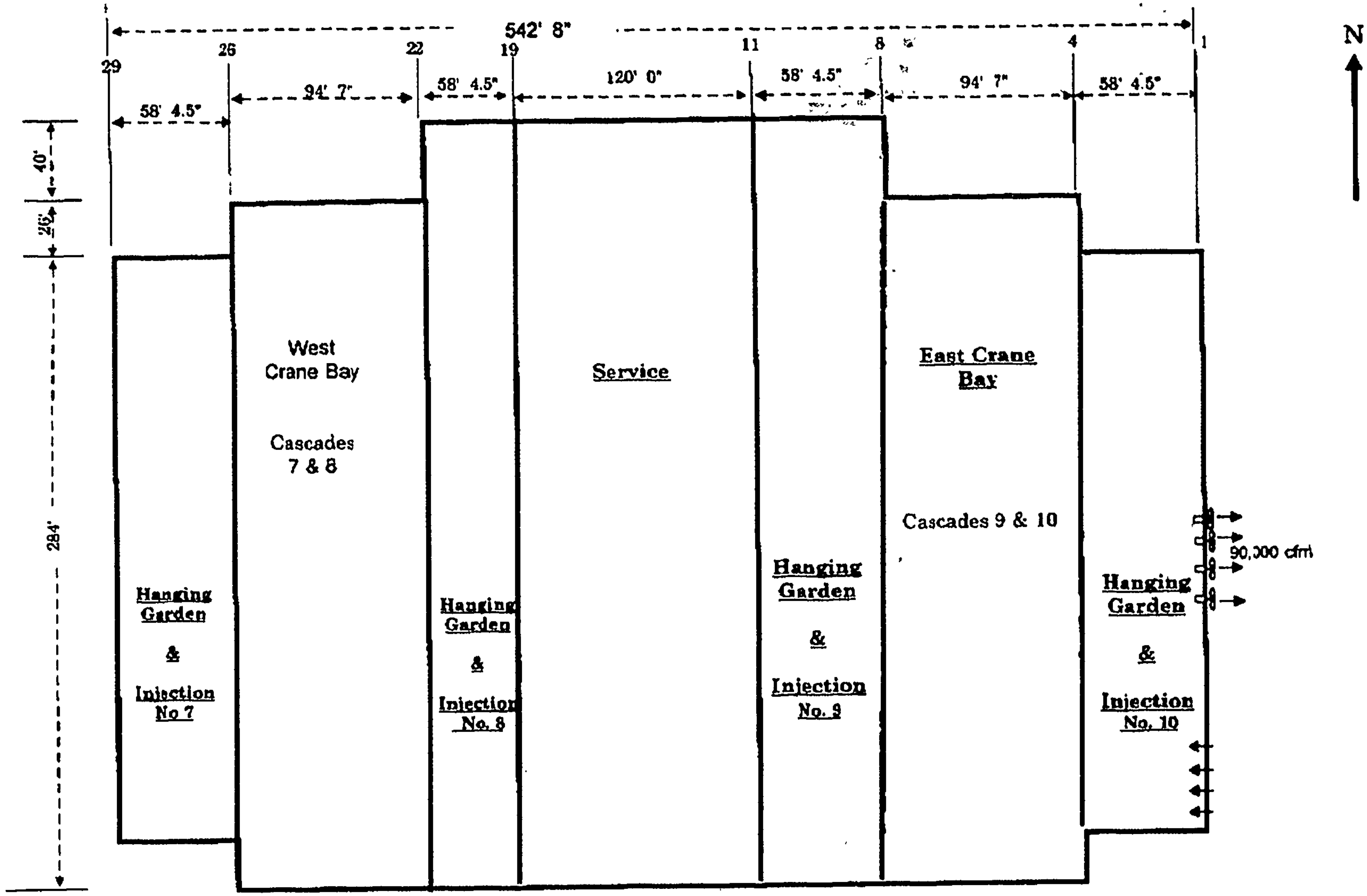


Figure 3
"3rd Floor Plan" -- Building 9201-4

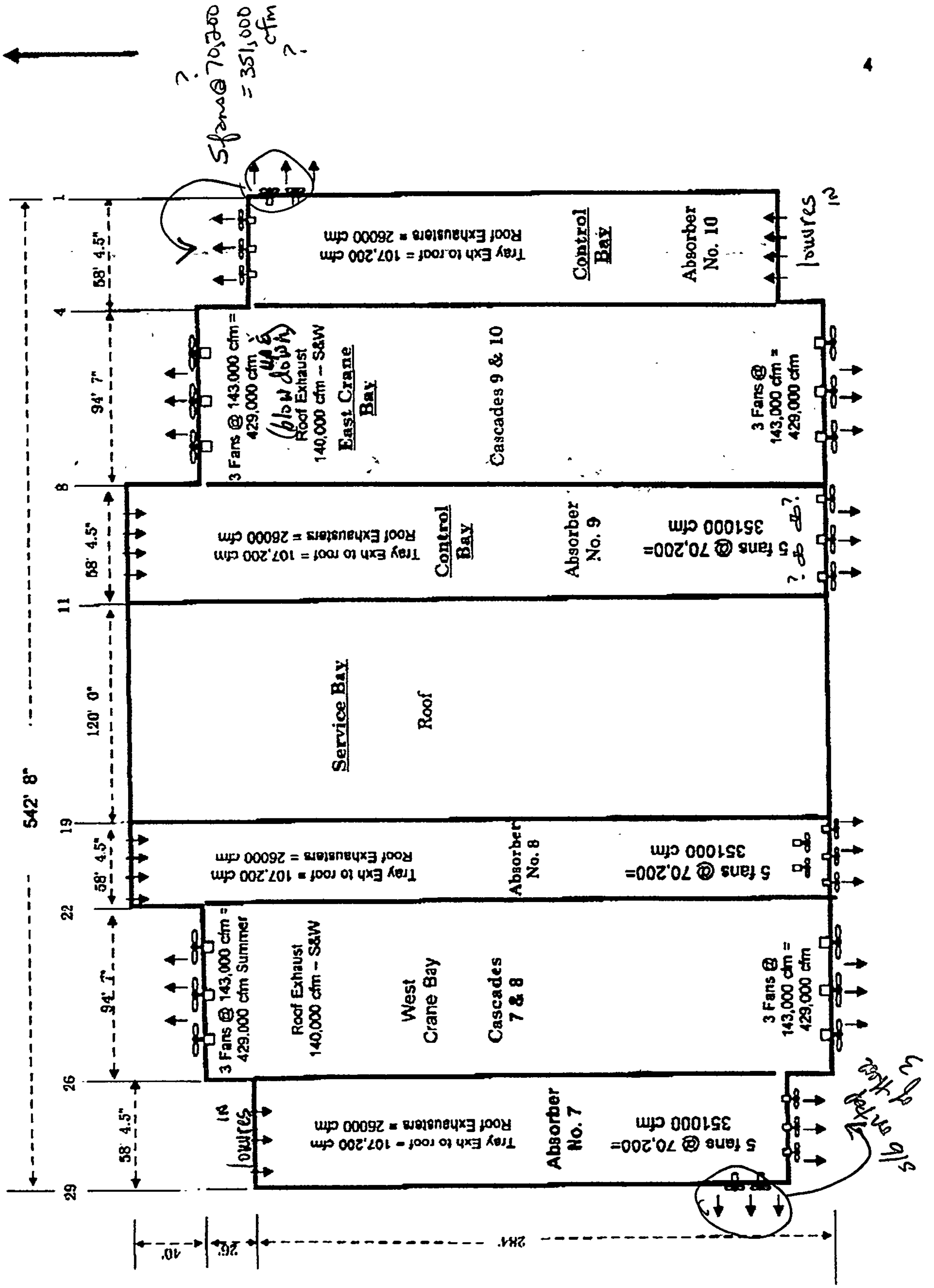
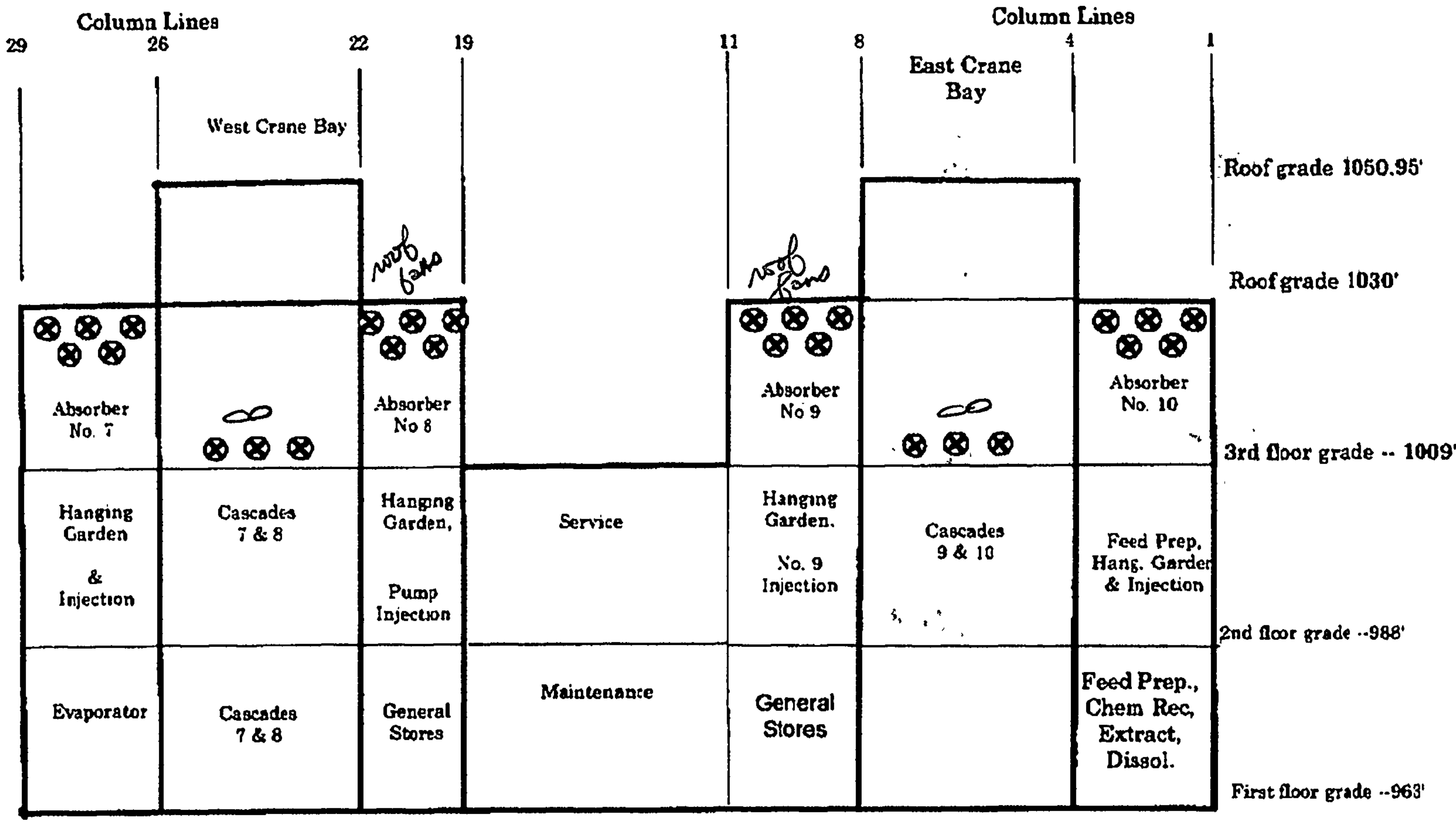


Figure 4
Section A · A (Looking North)---- Building 9201-4



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To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: E. E. Choat (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 7/27/96 Pages including this cover page -- 1

Message:
Yesterday, I received from you 5 ½ pages of industrial Hygiene reports and notes on 9201-2. In the middle of page 6, my FAX ran out of memory and that ended that.

At the time of that FAX -- my computer and printer was off – I was in Steve's office reading the notes that he had copied for you. Among those, there was only one that seemed to be of any help to me – the notes on 9201-2. Steve made a copy for me.

From what I have, there appears to be 8 pages in the document you were sending, and I have all of it.

If there's more, try me again.

My goal for today is to give you a report on 9204-4 before the end of the day.

E. E. Choat

FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: **E. E. Choat** (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 7/27/96 Pages including this cover page -- 6

Message:
This is to transmit the 1st draft of my final report for building 9204-4.

3rd try

E. E. Choat

FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: **E. E. Choat** (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 7/29/96 Pages including this cover page -- 5

Message:
This is to transmit the 1st draft of my final report for building 9201-2.

E. E. Choat

FACSIMILE COVER SHEET

August 1, 1996

Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Dear Susan:

This is transmit reports of buildings 9201-4, 9201-5, 9204-4, 9201-2, and 81-10. I believe that I have taken care of the comment you gave me on the phone. Call me if not or when there are more.

Sincerely,

E E Choat

E. E. Choat

DOCUMENT DESCRIPTION (Completed By Requesting Division) 8/2

Document No. Y/TS-1561 | Author's Telephone No. 6-0263 | Acct. No. 2366000 3 | Date of Request 7/29/96

Unclassified Title: VENTILATION SYSTEMS OF BUILDINGS 9201-4 AND 9201-5 AS EXISTED IN 1956 (DRAFT)

Author(s) E. E. CHOAT

TYPE: ☐ Formal Report ☐ Informal Report ☐ Progress/Status Report ☐ Co-Op Report ☐ Thesis/Term Paper

☐ Oral Presentation (identify meeting, sponsor, location, date):

☐ Journal Article (Identify Journal):

☒ Other (Specify): To Be Released to ChemRisk, Phase II

Document will be published in proceedings ☐ No ☐ Yes

Document will be distributed at meeting ☐ No ☐ Yes

Document has patent or invention significance ☐ No ☐ Yes (Identify)

Document has been previously released ☒ No ☐ Yes (Reference)

DIVISION REVIEW AND APPROVAL (Completed By Requesting Division)

TECHNICAL CLASSIFICATION REVIEW (Divisional Classification Representative)

Title(s): U Abstract: NA

DOCUMENT: Level U* Category —

R J Fraser 7/29/96
Signature Date

DOCUMENT REQUEST APPROVED (Division or Department)

[signature] 7/29/96
Signature Date

Signature Date

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DOCUMENT:

Level Unclassified Category —

Weapons Data — Sigma —

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☐ Date

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* Missing: 9201-5 - Fig. 1 & 2; 9201-4 - Fig. 1, 2, 3, & 4

FACSIMILE COVER SHEET

To: Susan M. Flack
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Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 8/6/96 Pages including this cover page -- 2

Message:
This is to transmit the 1st draft of my final report for Y-12 Steam Plants, Buildings 9401-1, 9401-2 & 9401-3.

E E Choat

E. E. Choat

August 8, 1996

Ventilation Systems of Building 9201-5 as Existed in 1956 – (revision 1) by E. E. Choat

Building Data

- Building 9201-5 is a large process building. It's overall size is ~~542~~ 543 feet x 312 feet. It has 3 floors and a total volume 9,471,300 ft^3. It has seven operating bays – East Crane Bay, West Crane Bay, 4 Control Bays, & 1 Service Bay.

350'?

- Figure 1 is a plan of the 3rd floor of the Colex Production Plant - 9201-5 - as it was in 1956. As seen here, "Absorbers" (a major process step) occupied the entire 3rd floor of three bays. Too "Cascades" occupied the entire area of two very large bays. The same Cascades also occupied the 1st and 3rd floors as well. This plan is included here to provide dimensional information on the structure, to show the location of various building processes, and the location of major ventilation exhaust points.

2nd?

- Figure 2 is a sectional view of the building. It is included here to provide pertinent building elevations, and to further identify the location of building processes.

- All building areas were contaminated with Mercury except the Service Area, & the Motor Generator Set Area. and Maintenance?

Ventilation

- The initial design of the ventilation systems for this building was done by an Architect Engineering Company – Catalytic Construction Company. Supervision of this design was done by Union Carbide Plant Engineering personnel. The HVAC Design Department was responsible for review and approval of all Heating, Ventilating, and Air Conditioning (HVAC) plans, and consequently, were intimately familiar with the details of these systems. J. C. Little was then the Head of the HVAC Design Department. At that time I worked in Jim Little's department as an HVAC Design Engineer.

- Construction of this design was completed in 1955, but did not provide sufficient ventilation to maintain acceptable contamination levels.

- These systems were then modified and upgraded in 1956 in an effort to reduce contamination levels. The design was done by Union

Figure 1
3rd Floor Plan -- Building 9201-5

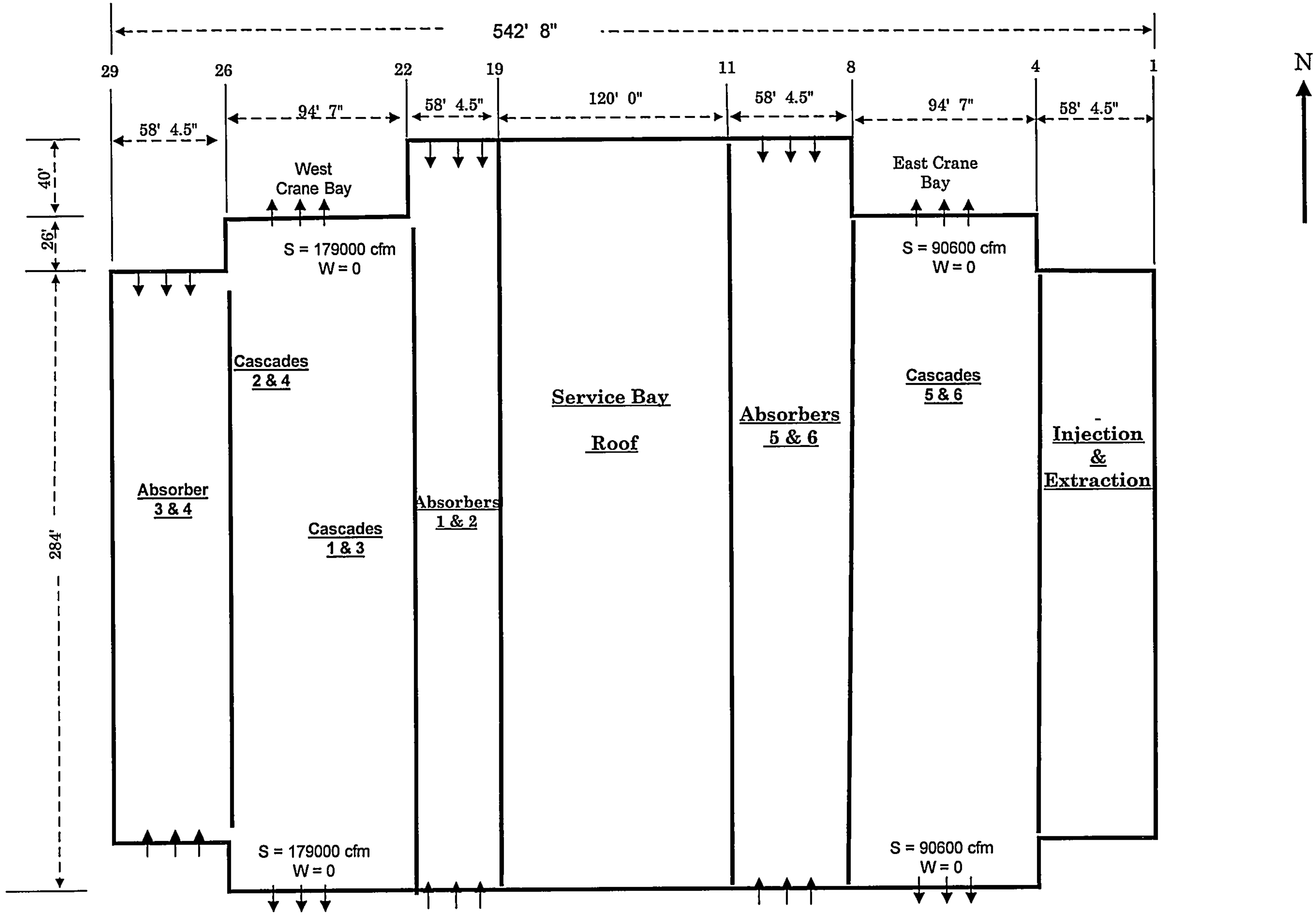
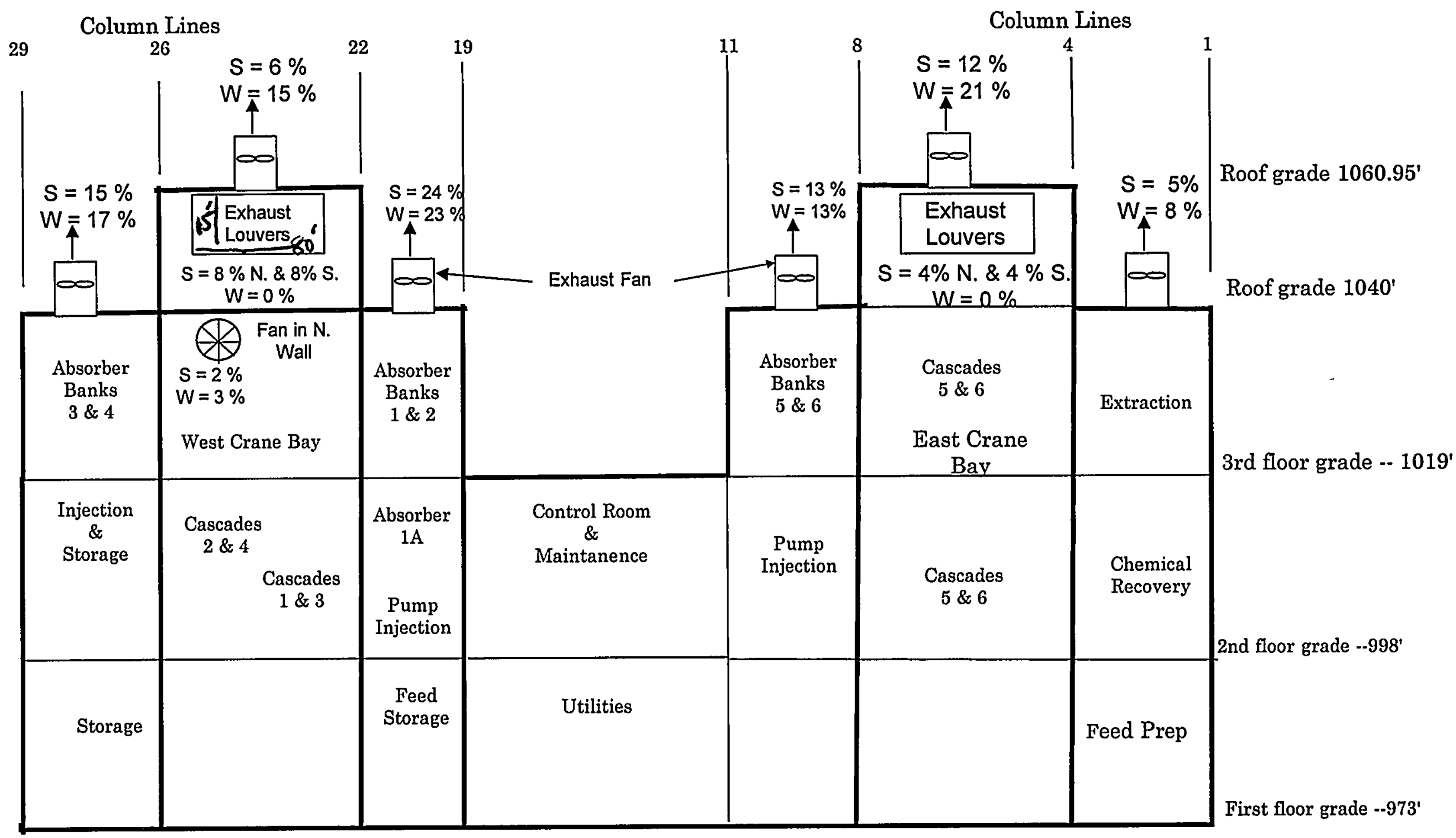


Figure 2
Section A - A ---- Building 9201-5



cfms not on drawing

- Carbide, HVAC Design Department personnel. J. C. Little, ~~the~~ was a major influence in these modifications.

- Subsequent to the shutdown of the Colex Production Plant in 9201-5, the building was stripped of all process equipment so that new and different processes could be installed. Ventilation systems were then modified as necessary to accommodate the requirements of the new process. During these modifications, drawings of the building ventilation systems were changed according to the new design, and consequently, no longer reflected conditions that existed in 1956.

- For this study, it has been necessary to search through existing drawings and documentation for sufficient information to reconstruct a model of the ventilation systems which existed in 1956. The most significant document of this search is a flow sheet identified as "General Ventilation - 9201-5" – it has no drawing number. This document:
  1. Is a diagram of all ventilation systems of 9201-5 as of 8/12/55.
  2. Was drawn by Don McAlister – a man who worked for the HVAC Design Department.
  3. It shows three designs:
     - the original Catalytic design
     - an upgraded ventilation design for winter operation
     - an upgraded ventilation design for summer operation

     Note:
     In this building, large surface areas of Mercury were exposed to the ambient air. As air temperatures increased from winter time to summer operation, more Mercury vaporized and entered the ambient air. Contamination levels ~~then,~~ therefore tended to increase during the summer months. To control the contamination level, higher ventilation rates were planned for summer.

The following table reflects the total ventilation provided by the original design, and for the upgraded design. The increases in ventilation shown here seem to be consistent with operating problems that were experienced and with documented evidence of modifications that were made for improvement.

	Contaminated Exhaust cfm		Building Air Change Rate ~~(based on Summer design)~~
	Winter	Summer	
Initial Design	1308545	1308545	8.3
Upgraded Design	~~1684410~~ ? 1526610		10.7
Upgraded Design		2357755	15.9

Details of the upgraded design for winter operation are summarized in Table 1. Here all major operations have been located with respect to building column lines and building floors. Too, air supplied and exhausted are given along with volumes of spaces and air change rates.

as built design.xls (sheet 2)

Table 1
Winter Ventilation Rates for 9201-5 Operations

							Contaminated
			Fresh Air	Air From	Room	Chgs.	Exh from
		Room	Supply	Floor Below	Exhaust	per	Building
System	Floor	Volume	cfm	cfm	Cfm	Hour	cfm
Cascade 5 & 6	1	661,000	108000	0	108000	9.8	34000
Cascade 5 & 6	2	402,500	184200	74000	258200	27.5	108000
Cascade 5 & 6	3	1,209,000	130200	150200	280400	6.5	280400
Feed Prep	1	297,000	10000	0	10000	2.0	10000
Chem.Rec.	2	248,500	25000	0	25000	6.0	25000
Extraction & Inject.	3	311,000	25000	0	25000	4.8	25000
Storage	1	297,000	18000	0	18000	3.6	18000
Hang gardens &Injection	2	248,500	20000	0	20000	4.8	20000
Absorbers 5 & 6	3	374,000	115000	0	115000	18.4	115000
Maintenance	1	842,000	80000	0	80000	5.7	
Service	2	561,500	77800	0	77800	8.3	
Feed Storage	1	297,000	50000	0	50000	10.1	50000
Hang G. & Inj.	2	219,800	71000	0	71000	19.4	71000
Absorbers 1 & 2	3	374,000	120000	0	120000	19.3	120000
Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	108000
Cascades 1&3 and 2&4	2	402,500	96000	0	96000	14.3	120000
Cascades 1&3 and 2&4	3	1,209,000	236400	-24000	236400	11.7	212400
Storage	1	297,000	18000	0	18000	3.6	1200
Hang G. & Inject	2	248,000	40000	16800	56800	9.7	56800
Absorbers No 3&4	3	311,000	151810	0	151810	29.3	151810
		9471300	1684410			10.7	1526610
Notes:							
1. Air Changes based upon fresh air supplied.							

440,400

Details of the upgraded design for winter operation are summarized in Table 1. Here all major operations have been located with respect to building column lines and building floors. Too, air supplied and exhausted are given along with volumes of spaces and air change rates.

Table 1
Winter Ventilation Rates for 9201-5 Operations

	Col	System	Floor	Same as A-4 Room Volume	Fresh Air Supply cfm	Air From Floor Below cfm	Room Exhaust Cfm	Chgs. per Hour (1)	Contaminated Exh from Building cfm	
310X95X	4-8	Cascade 5 & 6	1	661,000	108000	0	108000	9.8✓	34000	422,400
	4-8	Cascade 5 & 6	2	402,500	184200	74000 ✓	258200	27.5✓	108000	
	4-8	Cascade 5 & 6	3	1,209,000	130200	150200✓	280400	6.5	280400	
							0		0	
258X58X	1-4	~~Storage~~	1	297,000	10000	0	10000	2.0	10000	60,000
	1-4	Feed Prep	2	248,500	25000	0	25000	6.0	25000	
	1-4	Chem.Rec.	3	311,000	25000	0	25000	4.8	25000	
		Extraction and Injection					0		0	
350X58X	8-11	Storage	1	297,000	18000	0	18000	3.6	18000	153,000
	8-11	Hang gardens &Injection	2	248,500	20000	0	20000	4.8	20000	
	8-11	Absorbers 5 & 6	3	374,000	115000	0	115000	18.4	115000	
							0		0	
350X120X	11-19	Maintenance	1	842,000	80000	0	80000	5.7	0	
	11-19	Service	2	561,500	77800	0	77800	8.3	0	
							0		0	
350X58X	19-22	Feed Storage	1	297,000	50000	0	50000	10.1	50000	241,000
	19-22	Hang G. & Inj.	2	219,800	71000	0	71000	19.4	71000	
	19-22	Absorbers 1 & 2	3	374,000	120000	0	120000	19.3	120000	
							0		0	
310X95X	22-26	Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	108000	440,400
	22-26	Cascades 1&3 and 2&4	2	402,500	96000	0	96000	14.3	0 255910 ?	
	22-26	Cascades 1&3 and 2&4	3	1,209,000	236400	351910✓	588310	11.7	588310	696,310
							0		0	
258X58X	26-29	Storage	1	297,000	18000	0	18000	3.6	1200	209,810
	26-29	Hang G. & Inject	2	248,000	40000	16800✓	56800	9.7	56800	
	26-29	Absorbers ~~No~~ 3&4	3	311,000	151810	0	151810	29.3	151810	
				9471300	1684410	592910		10.7	1526610	?
		Notes:			✓					
		1. Air Changes based upon fresh air supplied.							1878520	

Q: why used fresh air supply here?

VS. 2,836,000 cfm
Y/EX-21

Details of the upgraded design for summer operation are summarized in Table 2. From this, it may be observed that ~~almost all of the building exhaust is from the 3rd floor.~~ In fact, ~~all is exhausted via roof fans except for 539,200 cfm that is exhausted via louvers~~ in the East & West Crane Bays. ✓

179000
179000
90600
90600

as built design.xls (sheet 2)

Table 2
Summer Ventilation Rates for 9201-5 Operations

Col	System	Floor	Room Volume	Fresh Air Supply cfm	Air From Fl. Below cfm	Room Exhaust Cfm	Chgs per Hour	Contaminated Exh from Building cfm	
4-8	Cascade 5 & 6	1	661,000	108000	0	108000	9.8✓	34000	555,755
4-8	Cascade 5 & 6	2	402,500	184755	74000✓	258755	27.5✓	36000	
4-8	Cascade 5 & 6	3	1,209,000	263000	222755✓	485755	13.1	485755	
						-0-		-0-	
1-4	~~Storage~~ 0	1	297,000	10000	0	10000	2.0	10000	60,000
1-4	Feed Prep	2	248,500	25000	0	25000	6.0	25000	
1-4	Chem.Rec. Extraction + Injection	3	311,000	25000	0	25000	4.8	25000	
						-0-			
8-11	Storage	1	297,000	18000	0	18000	3.6	5000	313,000
8-11	Hang gardens &Injection	2	248,500	20000	13000✓	33000	4.8	25600	
8-11	Absorbers 5 & 6	3	374,000	275000	7400✓	282400	44.1✓	282400	
						-0-			
11-19	Maintenance	1	842,000	80000	0	80000	5.7	0	
11-19	Service	2	561,500	77800	0	77800	8.3	0	
						0		-0-	
19-22	Feed Storage	1	297,000	50000	0	50000	10.1	50000	416,000
19-22	Hang G. & Inj.	2	219,800	76000	0	76000	20.7	76000	
19-22	Absorbers 1 & 2	3	374,000	290000	0	290000	46.5	290000	
						-0-		-0-	
22-26	Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	88000	706,000
22-26	Cascades 1, 2, 3,4	2	402,500	96000	20000	116000	14.3	120000	
22-26	Cascades 1, 2, 3,4	3	1,209,000	502000	? 1 24000	498000	24.9	498000	
						-0-		-0-	
26-29	Storage	1	297,000	18000	0	18000	3.6	1200	307000
26-29	Hang G. & Inject	2	248,000	40000	16800	56800	9.7	24000	
26-29	Absorbers ~~5&6~~ 3&4	3	311,000	249000	32800	281800	48.0	281800	
			9471300	2515555	~~382755~~		15.9	2357755	✓ o.k.

vs. 2,836,000 cfm

Table 3 is a tabulation of exhaust fan locations, design air volumes for summer and a calculated percentage of the building total.

Table 3
Fan Locations, Summer Air Volumes, & Per Cent of Total for Building Exhaust Points

					Exit
	grade	cfm	%	Orientation	Point
✓ W. Crane bay Roof exh	1061	140000	6%	up	roof
✓ East Crane Bay Roof Exh	1061	280000	12%	up	roof
✓ Absorbers 3&4	1040	210510	9%	up	roof
From Floors Below	1040	138500	6%	up	roof
✓ Absorber 1&2	1040	334875	14%	up	roof
From Floors Below	1040	237160	10%	up	roof
✓ Absorbers 5 & 6	1040	211470	9%	up	roof
From Floors Below	1040	99040	4%		roof
✓ Extraction	1040	127000	5%	up	roof
✓ W. Crane bay-- North wall	1050	179000	8%	horizontal	wall
✓ E. ~~S.~~ Crane bay -- So Wall	1050	179000	8%	horizontal	wall
✓ W. Crane bay-- North wall	1050	90600	4%	horizontal	wall
✓ E. ~~S.~~ Crane bay -- So Wall	1050	90600	4%	horizontal	wall
			~~0%~~		
✓ North Wall - 2nd Floor	1010	40000	2%	horizontal	wall
		2,357,755✓	100%✓		

15' H x 80' W louvers

~~3rd~~? on drawing

vs. 2,836,000 Y/EX-21

Table 4 contains data that is similar to that shown in Table 3, except it is for "winter" operation.

This percentages that were calculated in both table 3 and table 4 are also included in Figure 2 .

Table 4
Fan Locations, Winter Air Volumes, & Per Cent of Total for Building Exhaust Points

					Exit
	grade	cfm	%	Orientation	Point
W. Crane bay Roof exh	1061	232400	15%	up	Roof
East Crane Bay Roof Exh	1061	328000	21%	up	Roof
Absorbers 3&4	1040	115330	8%	up	Roof
From Floors Below	1040	138500	9%	up	Roof
				~~17%~~	
Absorber 1&2	1040	104590	7%	up	Roof
From Floors Below	1040	237160	16%	up	Roof
				~~22%~~	
Absorbers 5 & 6	1040	104590	7%	up	Roof
From Floors Below	1040	99040	6%		Roof
				~~13%~~	
Extraction	1040	127000	8%	up	Roof
W. Crane bay-- North wall	1050	0	0%	horizontal	~~Roof~~ wall (louvers)
E. ~~S.~~ Crane bay -- So Wall	1050	0	0%	horizontal	~~Roof~~ wall
North Wall -- 2nd Floor	1010	40000	3%	horizontal	~~Roof~~ wall
		1,526,610	100%		

vs.
2,836,000
Y/EK-21

Table 5 is a comparison of the Catalytic Design, the Upgrade Design, and ventilation rates as reported by J.C. Little, March 14, 1956. This comparison ~~would~~ indicates that Little was using "Summer" ventilation rates for his study. In view of a (very) close agreement of between Little's Report and Flow Sheet Data, this comparison ~~would~~ indicates that both were applicable to the same period of time.

sum-wint.xls

Table 5
Comparison of Flow Sheet Ventilation Rates with Those Reported by Little

			Exhaust Air Flow -- Cfm			
			From Vent. Flow Sheet			From Little
			Cat. Des.	Winter	Summer	Report
cols.	Operation	Floor		Upgraded	Upgraded	
1-4	Storage	1				
1-4	Feed Prep. & Extraction	2	35000	35000	35000	35000
1-4	Chemical Recovery	3	25000	25000	25000	25000
				60000✓	60000✓	
4-8	Cascades 5 & 6			34,000 422400		
4-8	All Floors	1,2&3	376400	↓ 388000 ?	555755✓	545000
				2600	2600	
8-11	Stores	1		↑155600	↑315600	
8-11	Injection Pumps 5 & 6	2	0	25600	25600	25600
8-11	Absorbers 5 & 6	3	99600	130000	290000	292000
19-22	Feed Storage	1	0	50000	50000	50000
19-22	Absorbers & Injection 1A	2	70325	71000	76000	50000
19-22	Injection Pumps 1 & 2	2	15000	↑ 50000 ?	↑ 50000 ?	24000
19-22	Absorbers 1 & 2	3	107110	120000	290000	292000
				291000	466000	
22-24	Cascades 1 & 3					
22-24	1st Floor		36000	44000 ?	44000	54000
22-24	2nd Floor		8000	40000	40000	60000
22-24	3rd & 4th Floor		202000	220200	249000	257000
			208,000	↑ 648,400	706,000✓	
24-26	Cascades 2 & 4					
24-26	1st Floor		36000	44000 ?	44000	54000
24-26	2nd Floor		8000	80000	80000	60000
24-26	3rd & 4th Floor		202000	220200	249000	257000
	Storage	1	54,000	↓ 155850	1890 ↓ 305110	
26-29	Absorbers 3 & 4	3	88110	131850	281110	292000
26-29	Injection Pumps 3 & 4	2	0	24000	24000	24000
	Totals		1308545✓	1698850	2408465	2396600✓

vs. ~~1698850~~ vs. 2357755

OR 1526610 on p.4

△172600 △50710

Table 6 is simply a repetition of Little's arithmetic. Input to this consist of air flow rates and concentration rates from Table 1 of Little's report. Other columns are simply details of the calculation. The resulting lbs/day effluent are the same as reported. ~~- of course.~~

Little~1.xls

Table 6
Validation of Little's Arithmetic

	building	Exhaust		Exhaust Concentration			
	col. lines	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day
Absorbers 1 & 2	19 - 22	292000	11907994	0.18	2143439	2143.439	4.73
Absorbers 3 & 4	26 - 29	292000	11907994	0.18	2143439	2143.439	4.73
Absorbers 5 & 6	8 - 11	292000	11907994	0.12	1428959	1428.959	3.15
Absorbers & Injection 1A	19 - 22	50000	2039040	0.28	570931.2	570.9312	1.26
Injection Pumps 1 & 2	22 - 26	24000	978739	0.3	293621.8	293.6218	0.65
Injection Pumps 3 & 4	26 - 29	24000	978739	0.25	244684.8	244.6848	0.54
Injection Pumps 5 & 6	8 - 11	25600	1043988	0.53	553313.9	553.3139	1.22
Chemical Recovery	1 - 4	25000	1019520	0.19	193708.8	193.7088	0.43
Feed Storage	19 - 22	50000	2039040	0.25	509760	509.76	1.12
Feed Prep. & Extraction	1 - 4	35000	1427328	0.1	142732.8	142.7328	0.31
Cascades 1 & 3	22 - 24						
1st Floor		54000	2202163	0.2	440432.6	440.4326	0.97
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.21	2200940	2200.94	4.85
Cascades 2 & 4	24 - 26						
1st Floor		54000	2202163	0.21	462454.3	462.4543	1.02
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.18	1886520	1886.52	4.16
Cascades 5 & 6	4 - 8						
All Floors		545000	22225536	0.13	2889320	2889.32	6.37
		2396600	97735265				38.31

References

1. Solvent Losses Through Ventilation Exhaust Systems, Building 9201-5, Little, J. C., March 14, 1956.
2. "General Ventilation - 9201-5", A Y-12 Drawing, – drawn by McAlister – 8/12/55.
3. Y/EX-24, Mercury at Y-12, (Unclassified version of Y/EX-21), Compiled by The 1983 Mercury Task Force, August 18, 1983.
4. Catalytic Construction drawings and design notes. dates?

Hgtot.n1.xls

Table 7
~~Sheet1~~

	Calculation for Hg Exhausted to Atmosphere from Building 9201-5										
					Bldg. Avg					Wilcox	
	Year		Exhaust x40.78		Conc.	÷1000	Effluent ÷453.5		x90d	Report	
		Qtr.	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day	1bs/qtr	1bs/qtr	
	1955	1	1308545	53363512 ✗	0.20	10672702	10672.7	23.53	2118	1716	
		2	1308545	53363512	0.15	8004527	8004.5	17.65	1588	1287	
		3	1308545	53363512	0.31	16542689	16542.7	36.47	3282	2573	
		4	1308545	53363512	0.21	11206338	11206.3	24.71	2223	3603	9212
			1526610	62256377		7470765	Annual	Totals	9212	9179	
1526610	1956	1	~~1684410~~	~~68691587~~	0.12	8242990	8243.0	18.17	~~1630~~	1888	1483
		2	2357755	96151135	0.10	9615114	9615.1	21.20	1908	1716	
		3	2357755	96151135	0.09	8653602	8653.6	19.08	1717	1544	
1526610		4	~~1684410~~	~~68691587~~	0.06	4121495	4121.5	9.09	~~818~~	1029	741
							Annual	Totals	~~6078~~	6177	5849
1526610	1957	1	~~1684410~~	~~68691587~~	0.04	2747663	2747.7	6.06	~~545~~	686	494
		2	2357755	96151135	0.04	3846045	3846.0	8.48	763	686	
		3	2357755	96151135	0.03	2884534	2884.5	6.36	572	515	
		4	~~1684410~~	~~68691587~~	0.02	1373832	1373.8	3.03	~~273~~	343	247
							Annual	Totals	~~2153~~	2230	2076
1526610	1958	1	~~1684410~~	~~68691587~~	0.02	1373832	1373.8	3.03	~~273~~	343	247
		2	2357755	96151135	0.02	1923023	1923.0	4.24	382	343	
		3	2357755	96151135	0.02	1923023	1923.0	4.24	382	343	
6610		4	~~1684410~~	~~68691587~~	0.03	2060748	2060.7	4.54	~~409~~	343	371
							Annual	Totals	~~1445~~	1372	1382
1526610	1959	1	~~1684410~~	~~68691587~~	0.04	2747663	2747.7	6.06	~~545~~	515	494
		2	471551(4)	19230227	0.05	961511.4	961.5	2.12	191		
		3	471551(4)	19230227	0.04	769209.1	769.2	1.70	153		
305332		4	~~336882(4)~~	~~13738317~~	0.03	412149.5	412.1	0.91	~~82~~		74
				12451683		s/b 412149.5	Annual	Totals	~~970~~	--	912
305332	1960	1	~~336882(4)~~	~~13738317~~	0.03	343457.9	412.1 343.5	0.91 0.76	~~68~~		74
		2	471551(4)	19230227	0.04	769209.1	769.2	1.70	153		
		3	471551(4)	19230227	0.05	961511.4	961.5	2.12	191		
305332		4	~~336882(4)~~	~~13738317~~	0.03	412149.5	412.1	0.91	~~82~~		74
							Annual	Totals	~~493~~	--	492
							Total for all years		~~20351~~	19473	19925 19920

373550.5

Notes:
1. Assumes "Winter" ventilation rates for 1st & 4th quarter.
2. Assumes "Summer" ventilation rates for 2nd & 3rd quarter.
3. Hg concentrations taken from "Wilcox" report, pg 110, with minor corrections by Susan Flack.
4. When process was shut down, ventilation was reduced to minimum as dictated by concentration level. It is estimated that the standby ventilation was 20% of the design rate.

August 1, 1996

Ventilation Systems of Building 9201-5 as Existed in 1956

by

E. E. Choat

Building Data

- Building 9201-5 is a large process building. It's overall size is 542 feet x 312 feet. It has 3 floors and a total volume 9,471,300 ft^3. It has seven operating bays – East Crane Bay, West Crane Bay, 4 Control Bays, & 1 Service Bay.

- Figure 1 is a plan of the 3[rd] floor of the Colex Production Plant - 9201-5 - as it was in 1956. As seen here, "Absorbers" (a major process step) occupied the entire 3[rd] floor of three bays. Too, "Cascades" occupied the entire area of two very large bays. The same Cascades also occupied the 1[st] and 3[rd] floors as well. This plan is included here to provide dimensional information on the structure, to show the location of various building processes, and the location of major ventilation exhaust points.

- Figure 2 is a sectional view of the building. It is included here to provide pertinent building elevations, and to further identify the location of building processes.

- All building areas were contaminated with Mercury except the Service Area, & the Motor Generator Set Area.

Ventilation

- The initial design of the ventilation systems for this building was done by an Architect Engineering Company – Catalytic Construction Company. Supervision of this design was done by Union Carbide Plant Engineering personnel. The HVAC Design Department was responsible for review and approval of all Heating, Ventilating, and Air Conditioning (HVAC) plans, and consequently, were intimately familiar with the details of these systems. J. C. Little was then the Head of the HVAC Design Department. At that time I worked in Jim Little's department as an HVAC Design Engineer.

- Construction of this design was completed in 1955, but did not provide sufficient ventilation to maintain acceptable contamination levels.

- These systems were then modified and upgraded in 1956 in an effort to reduce contamination levels. The design was done by Union

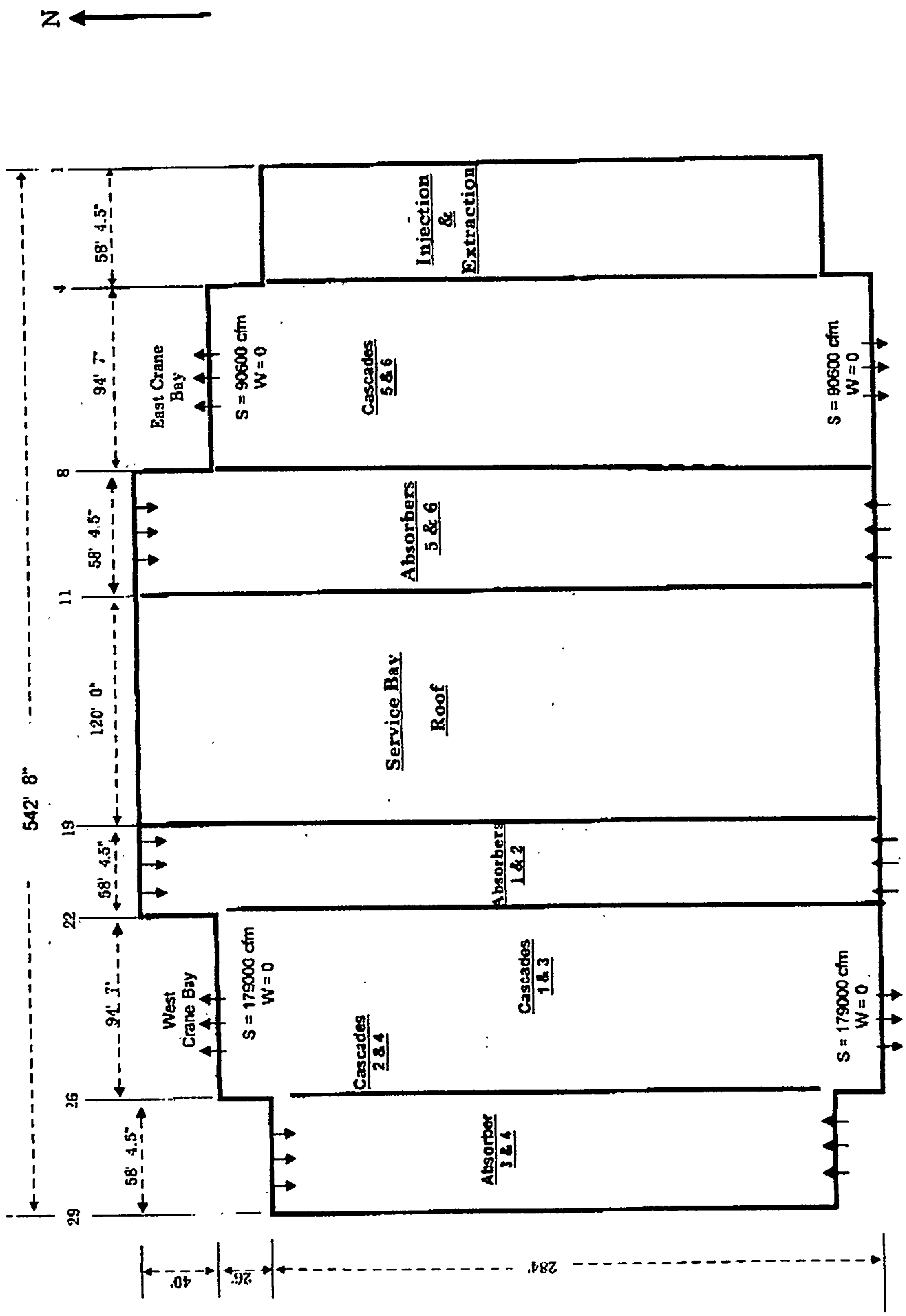
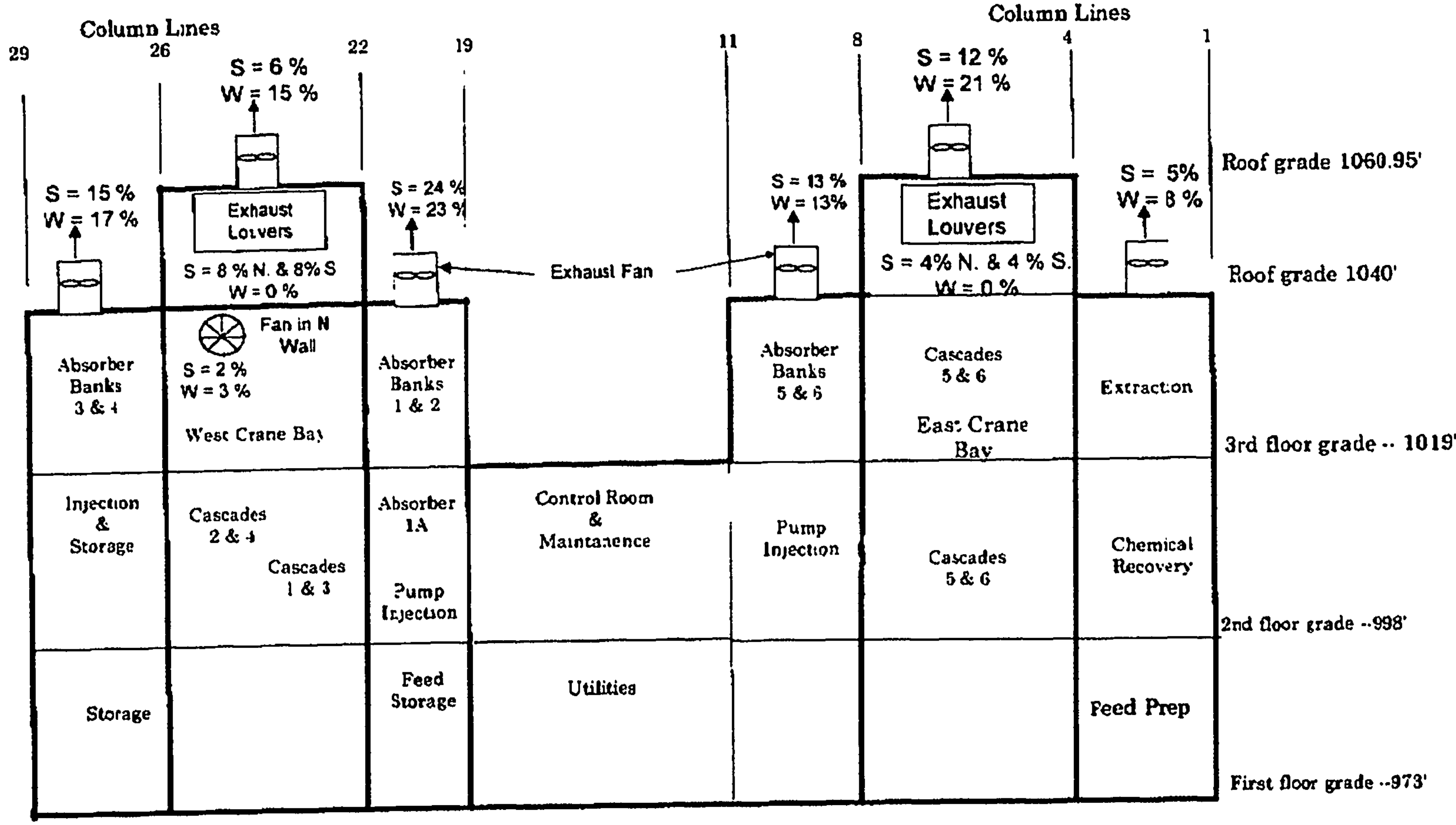


Figure 1
3rd Floor Plan -- Building 9201-5

Figure 2
Section A - A ---- Building 9201-5



- Carbide, HVAC Design Department personnel. J. C. Little, the was a major influence in these modifications.

- Subsequent to the shutdown of the Colex Production Plant in 9201-5, the building was stripped of all process equipment so that new and different processes could be installed. Ventilation systems were then modified as necessary to accommodate the requirements of the new process. During these modifications, drawings of the building ventilation systems were changed according to the new design, and consequently, no longer reflected conditions that existed in 1956.

- For this study, it has been necessary to search through existing drawings and documentation for sufficient information to reconstruct a model of the ventilation systems which existed in 1956. The most significant document of this search is a flow sheet identified as "General Ventilation - 9201-5" – it has no drawing number. This document:
  1. Is a diagram of all ventilation systems of 9201-5 as of 8/12/55.
  2. Was drawn by Don McAlister – a man who worked for the HVAC Design Department.
  3. It shows three designs:
     the original Catalytic design
     an upgraded ventilation design for winter operation
     an upgraded ventilation design for summer operation
        Note:
        In this building, large surface areas of Mercury were exposed to the ambient air. As air temperatures increased from winter time to summer operation, more Mercury vaporized and entered the ambient. Contamination levels, then, tended to increase during the summer months. To control the contamination level, higher ventilation rates were planned for summer.

The following table reflects the total ventilation provided by the original design, and for the upgraded design. The increases in ventilation shown here seem to be consistent with operating problems that were experienced and with documented evidence of modifications that were made for improvement.

	Contaminated Exhaust		Building Air Change Rate (based on Summer design)
	Winter	Summer	
Initial Design	1308545	1308545	8.3
Upgraded Design	1684410		10.7
Upgraded Design		2357755	15.9

Details of the upgraded design for winter operation are summarized in Table 1. Here all major operations have been located with respect to building column lines and building floors. Too, air supplied and exhausted are given along with volumes of spaces and air change rates.

Table 1
Winter Ventilation Rates for 9201-5 Operations

								Contaminated
				Fresh Air	Air From	Room	Chgs	Exh from
			Room	Supply	Floor Below	Exhaust	per	Building
Col	System	Floor	Volume	cfm	cfm	Cfm	Hour	cfm
4-8	Cascade 5 & 6	1	661,000	108000	0	108000	9.8	34000
4-8	Cascade 5 & 6	2	402,500	184200	74000	258200	27.5	108000
4-8	Cascade 5 & 6	3	1,209,000	130200	150200	280400	6.5	280400
						0		0
1-4	Storage	1	297,000	10000	0	10000	2.0	10000
1-4	Feed Prep	2	248,500	25000	0	25000	6.0	25000
1-4	Chem.Rec.	3	311,000	25000	0	25000	4.8	25000
						0		0
8-11	Storage	1	297,000	18000	0	18000	3.6	18000
8-11	Hang gardens &Injection	2	248,500	20000	0	20000	4.8	20000
8-11	Absorbers 5 & 6	3	374,000	115000	0	115000	18.4	115000
						0		0
11-19	Maintenance	1	842,000	80000	0	80000	5.7	
11-19	Service	2	561,500	77800	0	77800	8.3	
						0		0
19-22	Feed Storage	1	297,000	50000	0	50000	10.1	50000
19-22	Hang G. & Inj.	2	219,800	71000	0	71000	19.4	71000
19-22	Absorbers 1 & 2	3	374,000	120000	0	120000	19.3	120000
						0		0
22-26	Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	108000
22-26	Cascades 1&3 and 2&4	2	402,500	96000	0	96000	14.3	-255910
22-26	Cascades 1&3 and 2&4	3	1,209,000	236400	351910	588310	11.7	588310
						0		0
26-29	Storage	1	297,000	18000	0	18000	3.6	1200
26-29	Hang G. & Inject	2	248,000	40000	16800	56800	9.7	56800
26-29	Absorber No 3&4	3	311,000	151810	0	151810	29.3	151810
			9471300	1684410	592910		10.7	1526610
	Notes:							
	1. Air Changes based upon fresh air supplied.							

Details of the upgraded design for summer operation are summarized in Table 2. From this, it may be observed that almost all of the building exhaust is from the 3rd floor. In fact, all is exhausted via roof fans except for 539,200 cfm that is exhausted via louvers in the East & West Crane Bays.

Table 2
Summer Ventilation Rates for 9201-5 Operations

Col	System	Floor	Room Volume	Fresh Air Supply cfm	Air From Fl. Below cfm	Room Exhaust Cfm	Chgs per Hour	Contaminated Exh from Building cfm
4-8	Cascade 5 & 6	1	661,000	108000	0	108000	9.8	34000
4-8	Cascade 5 & 6	2	402,500	184755	74000	258755	27.5	36000
4-8	Cascade 5 & 6	3	1,209,000	263000	222755	485755	13.1	485755
						0		0
1-4	Storage	1	297,000	10000	0	10000	2.0	10000
1-4	Feed Prep	2	248,500	25000	0	25000	6.0	25000
1-4	Chem.Rec.	3	311,000	25000	0	25000	4.8	25000
						0		
8-11	Storage	1	297,000	18000	0	18000	3.6	5000
8-11	Hang gardens &Injection	2	248,500	20000	13000	33000	4.8	25600
8-11	Absorbers 5 & 6	3	374,000	275000	7400	282400	44.1	282400
						0		
11-19	Maintenance	1	842,000	80000	0	80000	5.7	
11-19	Service	2	561,500	77800	0	77800	8.3	
						0		0
19-22	Feed Storage	1	297,000	50000	0	50000	10.1	50000
19-22	Hang G. & Inj.	2	219,800	76000	0	76000	20.7	76000
19-22	Absorbers 1 & 2	3	374,000	290000	0	290000	46.5	290000
						0		0
22-26	Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	88000
22-26	Cascades 1, 2, 3,4	2	402,500	96000	20000	116000	14.3	120000
22-26	Cascades 1, 2, 3,4	3	1,209,000	502000	-4000	498000	24.9	498000
						0		0
26-29	Storage	1	297,000	18000	0	18000	3.6	1200
26-29	Hang G. & Inject	2	248,000	40000	16800	56800	9.7	24000
26-29	Absorber No 3&4	3	311,000	249000	32800	281800	48.0	281800
			9471300	2515555	382755		15.9	2357755

Table 3 is a tabulation of exhaust fan locations, design air volumes for summer and a calculated percentage of the building total.

Table 3
Fan Locations, Summer Air Volumes, & Per Cent of Total for Building Exhaust Points

	grade	cfm	%	Orientation	Exit Point
W. Crane bay Roof exh	1061	140000	6%	up	roof
East Crane Bay Roof Exh	1061	280000	12%	up	roof
Absorbers 3&4	1040	210510	9%	up	roof
From Floors Below	1040	138500	6%	up	roof
Absorber 1&2	1040	334875	14%	up	roof
From Floors Below	1040	237160	10%	up	roof
Absorbers 5 & 6	1040	211470	9%	up	roof
From Floors Below	1040	99040	4%		roof
Extraction	1040	127000	5%	up	roof
W. Crane bay-- North wall	1050	179000	8%	horizontal	wall
S. Crane bay -- So Wall	1050	179000	8%	horizontal	wall
W. Crane bay-- North wall	1050	90600	4%	horizontal	wall
S. Crane bay -- So Wall	1050	90600	4%	horizontal	wall
			0%		
North Wall -- 2nd Floor	1010	40000	2%	horizontal	wall
		2357755	100%		

Table 4 contains data that is similar to that shown in Table 3, except it is for "winter" operation.

This percentages that were calculated in both table 3 and table 4 are also included in Figure 2 .

Table 4
Fan Locations, Winter Air Volumes, & Per Cent of Total for Building Exhaust Points

	grade	cfm	%	Orientation	Exit Point
W. Crane bay Roof exh	1061	232400	15%	up	Roof
East Crane Bay Roof Exh	1061	328000	21%	up	Roof
Absorbers 3&4	1040	115330	8%	up	Roof
From Floors Below	1040	138500	9%	up	Roof
				17%	
Absorber 1&2	1040	104590	7%	up	Roof
From Floors Below	1040	237160	16%	up	Roof
				22%	
Absorbers 5 & 6	1040	104590	7%	up	Roof
From Floors Below	1040	99040	6%		Roof
				13%	
Extraction	1040	127000	8%	up	Roof
W. Crane bay-- North wall	1050	0	0%	horizontal	Roof
S. Crane bay -- So Wall	1050	0	0%	horizontal	Roof
North Wall -- 2nd Floor	1010	40000	3%	horizontal	Roof
		1526610	100%		

Table 5 is a comparison of the Catalytic Design, the Upgrade Design, and ventilation rates as reported by J.C. Little, March 14, 1956. This comparison would indicate that Little was using "Summer" ventilation rates for his study. In view of a very close agreement of between Little's Report and Flow Sheet Data,. this comparison would indicate that both were applicable to the same period of time.

Table 5
Comparison of Flow Sheet Ventilation Rates with Those Reported by Little

			Exhaust Air Flow -- Cfm			
			From Vent. Flow Sheet			From Little
			Cat. Des.	Winter	Summer	Report
cols.	Operation	Floor				
1-4	Storage	1				
1-4	Feed Prep. & Extraction	2	35000	35000	35000	35000
1-4	Chemical Recovery	3	25000	25000	25000	25000
4-8	Cascades 5 & 6					
4-8	All Floors	1,2&3	370400	388000	555755	545000
8-11	Stores	1				
8-11	Injection Pumps 5 & 6	2	0	25600	25600	25600
8-11	Absorbers 5 & 6	3	99600	130000	290000	292000
19-22	Feed Storage	1	0	50000	50000	50000
19-22	Absorbers & Injection 1A	2	70325	71000	76000	50000
19-22	Injection Pumps 1 & 2	2	15000	50000	50000	24000
19-22	Absorbers 1 & 2	3	107110	120000	290000	292000
22-24	Cascades 1 & 3					
22-24	1st Floor		36000	44000	44000	54000
22-24	2nd Floor		8000	40000	40000	60000
22-24	3rd & 4th Floor		202000	220200	249000	257000
24-26	Cascades 2 & 4					
24-26	1st Floor		36000	44000	44000	54000
24-26	2nd Floor		8000	80000	80000	60000
24-26	3rd & 4th Floor		202000	220200	249000	257000
26-29	Absorbers 3 & 4	3	88110	131850	281110	292000
26-29	Injection Pumps 3 & 4	2	0	24000	24000	24000
	Totals		1308545	1698850	2408465	2396600

Table 6 is simply a repetition of Little's arithmetic. Input to this consist of air flow rates and concentration rates from Table 1 of Little's report. Other columns are simply details of the calculation. The resulting lbs/day effluent are the same as reported – of course.

Table 6
Validation of Little's Arithmetic

	building	Exhaust		Concentration			
	col. lines	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day
Absorbers 1 & 2	19 - 22	292000	11907994	0.18	2143439	2143.439	4.73
Absorbers 3 & 4	26 - 29	292000	11907994	0.18	2143439	2143.439	4.73
Absorbers 4 & 5	8 - 11	292000	11907994	0.12	1428959	1428.959	3.15
Absorbers & Injection 1A	19 - 22	50000	2039040	0.28	570931.2	570.9312	1.26
Injection Pumps 1 & 2	22 - 26	24000	978739	0.3	293621.8	293.6218	0.65
Injection Pumps 3 & 4	26 - 29	24000	978739	0.25	244684.8	244.6848	0.54
Injection Pumps 5 & 6	8 - 11	25600	1043988	0.53	553313.9	553.3139	1.22
Chemical Recovery	1 - 4	25000	1019520	0.19	193708.8	193.7088	0.43
Feed Storage	19 - 22	50000	2039040	0.25	509760	509.76	1.12
Feed Prep. & Extraction	1 - 4	35000	1427328	0.1	142732.8	142.7328	0.31
Cascades 1 & 3	22 - 24						
1st Floor		54000	2202163	0.2	440432.6	440.4326	0.97
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.21	2200940	2200.94	4.85
Cascades 2 & 4	24 - 26						
1st Floor		54000	2202163	0.21	462454.3	462.4543	1.02
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.18	1886520	1886.52	4.16
Cascades 5 & 6	4 - 8						
All Floors		545000	22225536	0.13	2889320	2889.32	6.37
		2396600	97735265				38.31

References

1. Solvent Losses Through Ventilation Exhaust Systems. Building 9201-5, Little, J. C., March 14, 1956.
2. "General Ventilation - 9201-5", A Y-12 Drawing, – drawn by McAlister – 8/12/55.
3. Y/EX-24, Mercury at Y-12, (Unclassified version of Y/EX-21), Compiled by The 1083 Mercury Task Force, August 18, 1983.
4. Catalytic Construction drawings and design notes.

August 1, 1996

Ventilation Systems of Building 9201-5
as Existed in 1956
by
E. E. Choat

Building Data

- Building 9201-5 is a large process building. It's overall size is 542 feet x 312 feet. It has 3 floors and a total volume 9,471,300 ft^3. It has seven operating bays – East Crane Bay, West Crane Bay, 4 Control Bays, & 1 Service Bay.

- Figure 1 is a plan of the 3rd floor of the Colex Production Plant - 9201-5 - as it was in 1956. As seen here, "Absorbers" (a major process step) occupied the entire 3rd floor of three bays. Too, "Cascades" occupied the entire area of two very large bays. The same Cascades also occupied the 1st and 3rd floors as well. This plan is included here to provide dimensional information on the structure, to show the location of various building processes, and the location of major ventilation exhaust points.

- Figure 2 is a sectional view of the building. It is included here to provide pertinent building elevations, and to further identify the location of building processes.

- All building areas were contaminated with Mercury except the Service Area, & the Motor Generator Set Area.

Ventilation

- The initial design of the ventilation systems for this building was done by an Architect Engineering Company – Catalytic Construction Company. Supervision of this design was done by Union Carbide Plant Engineering personnel. The HVAC Design Department was responsible for review and approval of all Heating, Ventilating, and Air Conditioning (HVAC) plans, and consequently, were intimately familiar with the details of these systems. J. C. Little was then the Head of the HVAC Design Department. At that time I worked in Jim Little's department as an HVAC Design Engineer.

- Construction of this design was completed in 1955, but did not provide sufficient ventilation to maintain acceptable contamination levels.

- These systems were then modified and upgraded in 1956 in an effort to reduce contamination levels. The design was done by Union

Figure 1
3rd Floor Plan -- Building 9201-5

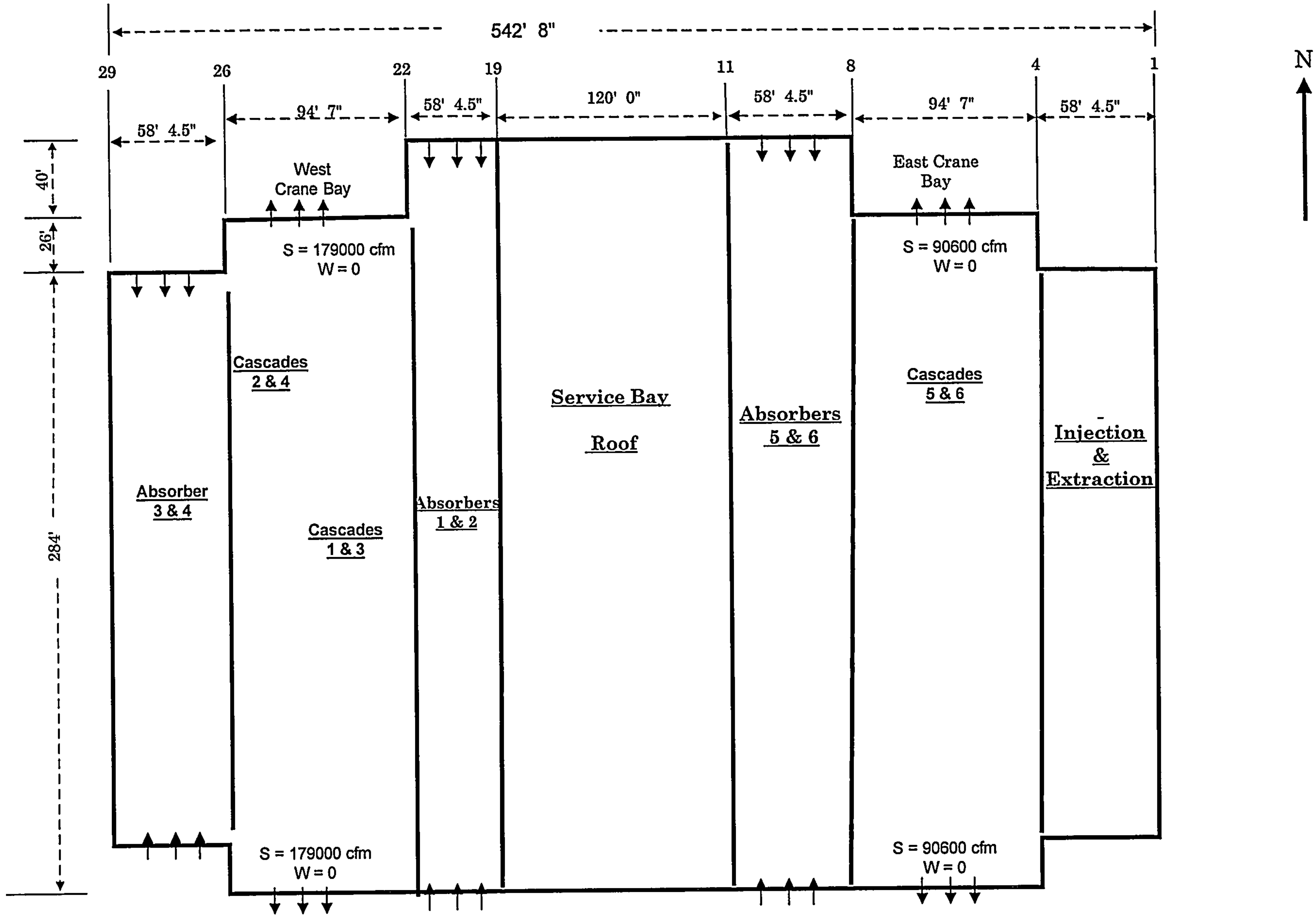
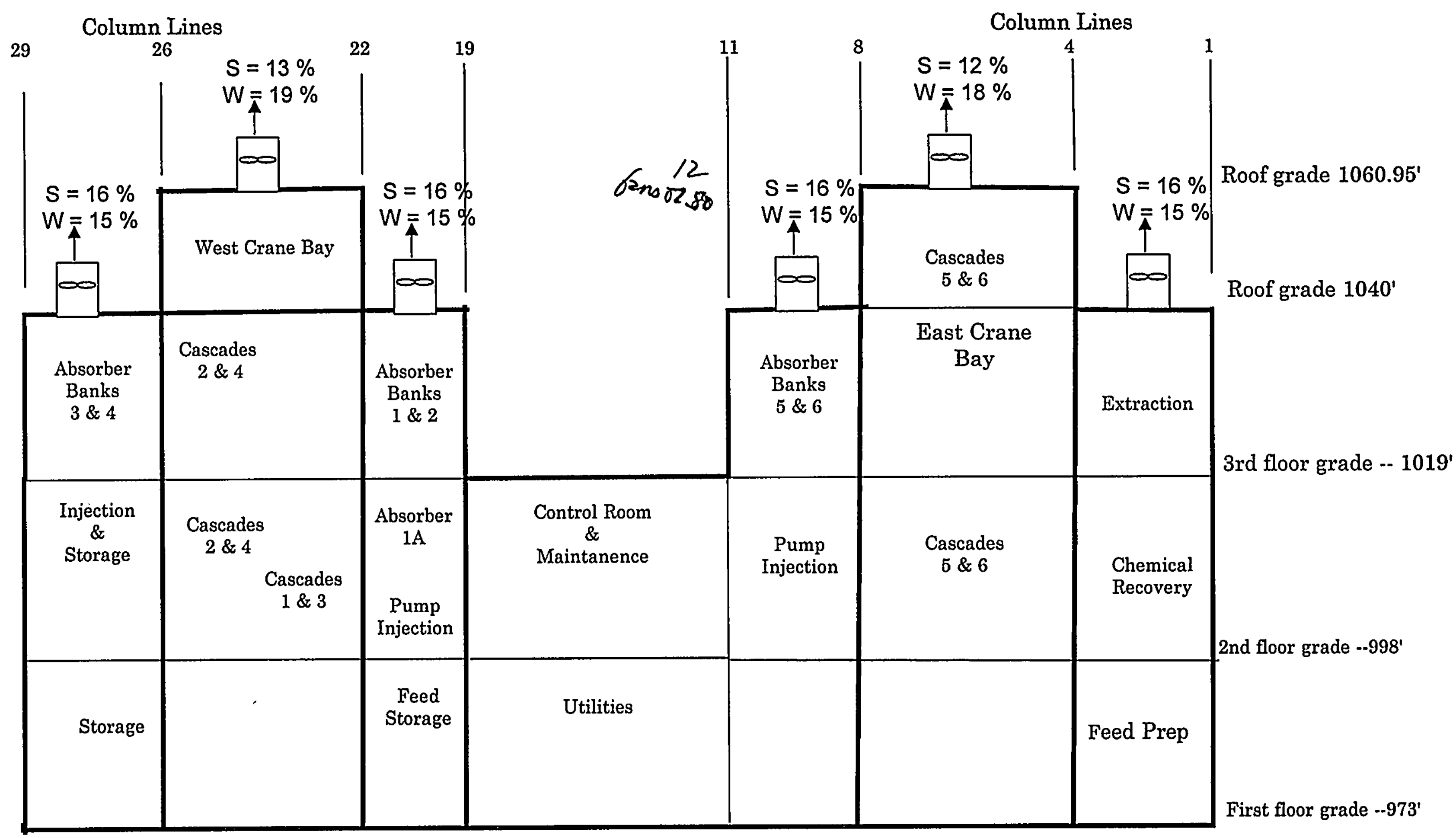


Figure 2
Section A - A ---- Building 9201-5



- Carbide, HVAC Design Department personnel. J. C. Little, the was a major influence in these modifications.

- Subsequent to the shutdown of the Colex Production Plant in 9201-5, the building was stripped of all process equipment so that new and different processes could be installed. Ventilation systems were then modified as necessary to accommodate the requirements of the new process. During these modifications, drawings of the building ventilation systems were changed according to the new design, and consequently, no longer reflected conditions that existed in 1956.

- For this study, it has been necessary to search through existing drawings and documentation for sufficient information to reconstruct a model of the ventilation systems which existed in 1956. The most significant document of this search is a flow sheet identified as "General Ventilation - 9201-5" – it has no drawing number. This document:
  1. Is a diagram of all ventilation systems of 9201-5 as of 8/12/55.
  2. Was drawn by Don McAlister – a man who worked for the HVAC Design Department.
  3. It shows three designs:
     - the original Catalytic design
     - an upgraded ventilation design for winter operation
     - an upgraded ventilation design for summer operation

       Note:
       In this building, large surface areas of Mercury were exposed to the ambient air. As air temperatures increased from winter time to summer operation, more Mercury vaporized and entered the ambient. Contamination levels, then, tended to increase during the summer months. To control the contamination level, higher ventilation rates were planned for summer.

The following table reflects the total ventilation provided by the original design, and for the upgraded design. The increases in ventilation shown here seem to be consistent with operating problems that were experienced and with documented evidence of modifications that were made for improvement.

	Contaminated Exhaust		Building Air Change Rate (based on Summer design)
	Winter	Summer	
Initial Design	1308545	1308545	8.3
Upgraded Design	1684410		10.7
Upgraded Design		2357755	15.9

Details of the upgraded design for winter operation are summarized in Table 1. Here all major operations have been located with respect to building column lines and building floors. Too, air supplied and exhausted are given along with volumes of spaces and air change rates.

Table 1
Winter Ventilation Rates for 9201-5 Operations

Col	System	Floor	Room Volume	Fresh Air Supply cfm	Air From Floor Below cfm	Room Exhaust Cfm	Chgs. per Hour	Contaminated Exh from Building cfm
4-8	Cascade 5 & 6	1	661,000	108000	0	108000	9.8	34000
4-8	Cascade 5 & 6	2	402,500	184200	74000	258200	27.5	108000
4-8	Cascade 5 & 6	3	1,209,000	130200	150200	280400	6.5	280400
						0		0
1-4	Storage	1	297,000	10000	0	10000	2.0	10000
1-4	Feed Prep	2	248,500	25000	0	25000	6.0	25000
1-4	Chem.Rec.	3	311,000	25000	0	25000	4.8	25000
						0		0
8-11	Storage	1	297,000	18000	0	18000	3.6	18000
8-11	Hang gardens &Injection	2	248,500	20000	0	20000	4.8	20000
8-11	Absorbers 5 & 6	3	374,000	115000	0	115000	18.4	115000
						0		0
11-19	Maintenance	1	842,000	80000	0	80000	5.7	
11-19	Service	2	561,500	77800	0	77800	8.3	
						0		0
19-22	Feed Storage	1	297,000	50000	0	50000	10.1	50000
19-22	Hang G. & Inj.	2	219,800	71000	0	71000	19.4	71000
19-22	Absorbers 1 & 2	3	374,000	120000	0	120000	19.3	120000
						0		0
22-26	Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	108000
22-26	Cascades 1&3 and 2&4	2	402,500	96000	0	96000	14.3	-255910
22-26	Cascades 1&3 and 2&4	3	1,209,000	236400	351910	588310	11.7	588310
						0		0
26-29	Storage	1	297,000	18000	0	18000	3.6	1200
26-29	Hang G. & Inject	2	248,000	40000	16800	56800	9.7	56800
26-29	Absorber No 3&4	3	311,000	151810	0	151810	29.3	151810
			9471300	1684410	592910		10.7	1526610
	Notes:							
	1. Air Changes based upon fresh air supplied.							

Details of the upgraded design for summer operation are summarized in Table 2. From this, it may be observed that almost all of the building exhaust is from the 3rd floor. In fact, all is exhausted via roof fans except for 539,200 cfm that is exhausted via louvers in the East & West Crane Bays.

Table 2
Summer Ventilation Rates for 9201-5 Operations

Col	System	Floor	Room Volume	Fresh Air Supply cfm	Air From Fl. Below cfm	Room Exhaust Cfm	Chgs per Hour	Contaminated Exh from Building cfm
4-8	Cascade 5 & 6	1	661,000	108000	0	108000	9.8	34000
4-8	Cascade 5 & 6	2	402,500	184755	74000	258755	27.5	36000
4-8	Cascade 5 & 6	3	1,209,000	263000	222755	485755	13.1	485755
						0		0
1-4	Storage	1	297,000	10000	0	10000	2.0	10000
1-4	Feed Prep	2	248,500	25000	0	25000	6.0	25000
1-4	Chem.Rec.	3	311,000	25000	0	25000	4.8	25000
						0		
8-11	Storage	1	297,000	18000	0	18000	3.6	5000
8-11	Hang gardens &Injection	2	248,500	20000	13000	33000	4.8	25600
8-11	Absorbers 5 & 6	3	374,000	275000	7400	282400	44.1	282400
						0		
11-19	Maintenance	1	842,000	80000	0	80000	5.7	
11-19	Service	2	561,500	77800	0	77800	8.3	
						0		0
19-22	Feed Storage	1	297,000	50000	0	50000	10.1	50000
19-22	Hang G. & Inj.	2	219,800	76000	0	76000	20.7	76000
19-22	Absorbers 1 & 2	3	374,000	290000	0	290000	46.5	290000
						0		0
22-26	Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	88000
22-26	Cascades 1, 2, 3,4	2	402,500	96000	20000	116000	14.3	120000
22-26	Cascades 1, 2, 3,4	3	1,209,000	502000	-4000	498000	24.9	498000
						0		0
26-29	Storage	1	297,000	18000	0	18000	3.6	1200
26-29	Hang G. & Inject	2	248,000	40000	16800	56800	9.7	24000
26-29	Absorber No 3&4	3	311,000	249000	32800	281800	48.0	281800
			9471300	2515555	382755		15.9	2357755

From Tables 1 & 2 and also from Figure 2, building exhaust is distributed as follows:

	Exhaust Volume cfm	% via Roof at Elevation 1061'	% via Roof at Elevation 1040'	% via Walls at Elevation 1050
Summer	2357755	37	61	2
Winter	1526610	25	64	1

Table 3 is a comparison of the Catalytic Design, the Upgrade Design, and ventilation rates as reported by J.C. Little, March 14, 1956. This comparison would indicate that Little was using "Summer" ventilation rates for his study. In view of a very close agreement of between Little's Report and Flow Sheet Data, this comparison would indicate that both were applicable to the same period of time.

Table 3
Comparison of Flow Sheet Ventilation Rates with Those Reported by Little

			Exhaust Air Flow -- Cfm			
			From Vent. Flow Sheet			From Little
			Cat. Des.	Winter	Summer	Report
cols.	Operation	Floor				
1-4	Storage	1				
1-4	Feed Prep. & Extraction	2	35000	35000	35000	35000
1-4	Chemical Recovery	3	25000	25000	25000	25000
4-8	Cascades 5 & 6					
4-8	All Floors	1,2&3	376400	388000	555755	545000
8-11	Stores	1				
8-11	Injection Pumps 5 & 6	2	0	25600	25600	25600
8-11	Absorbers 5 & 6	3	99600	130000	290000	292000
19-22	Feed Storage	1	0	50000	50000	50000
19-22	Absorbers & Injection 1A	2	70325	71000	76000	50000
19-22	Injection Pumps 1 & 2	2	15000	50000	50000	24000
19-22	Absorbers 1 & 2	3	107110	120000	290000	292000
22-24	Cascades 1 & 3					
22-24	1st Floor		36000	44000	44000	54000
22-24	2nd Floor		8000	40000	40000	60000
22-24	3rd & 4th Floor		202000	220200	249000	257000
24-26	Cascades 2 & 4					
24-26	1st Floor		36000	44000	44000	54000
24-26	2nd Floor		8000	80000	80000	60000
24-26	3rd & 4th Floor		202000	220200	249000	257000
26-29	Absorbers 3 & 4	3	88110	131850	281110	292000
26-29	Injection Pumps 3 & 4	2	0	24000	24000	24000
	Totals		1308545	1698850	2408465	2396600

Table 4 is simply a repetition of Little's arithmetic. Input to this consist of air flow rates and concentration rates from Table 1 of Little's report. Other columns are simply details of the calculation. The resulting lbs/day effluent are the same as reported – of course.

Table 4
Validation of Little's Arithmetic

	building	Exhaust		Concentration			
	col. lines	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day
Absorbers 1 & 2	19 - 22	292000	11907994	0.18	2143439	2143.439	4.73
Absorbers 3 & 4	26 - 29	292000	11907994	0.18	2143439	2143.439	4.73
Absorbers 4 & 5	8 - 11	292000	11907994	0.12	1428959	1428.959	3.15
Absorbers & Injection 1A	19 - 22	50000	2039040	0.28	570931.2	570.9312	1.26
Injection Pumps 1 & 2	22 - 26	24000	978739	0.3	293621.8	293.6218	0.65
Injection Pumps 3 & 4	26 - 29	24000	978739	0.25	244684.8	244.6848	0.54
Injection Pumps 5 & 6	8 - 11	25600	1043988	0.53	553313.9	553.3139	1.22
Chemical Recovery	1 - 4	25000	1019520	0.19	193708.8	193.7088	0.43
Feed Storage	19 - 22	50000	2039040	0.25	509760	509.76	1.12
Feed Prep. & Extraction	1 - 4	35000	1427328	0.1	142732.8	142.7328	0.31
Cascades 1 & 3	22 - 24						
1st Floor		54000	2202163	0.2	440432.6	440.4326	0.97
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.21	2200940	2200.94	4.85
Cascades 2 & 4	24 - 26						
1st Floor		54000	2202163	0.21	462454.3	462.4543	1.02
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.18	1886520	1886.52	4.16
Cascades 5 & 6	4 - 8						
All Floors		545000	22225536	0.13	2889320	2889.32	6.37
		2396600	97735265				38.31

References

1. Solvent Losses Through Ventilation Exhaust Systems, Building 9201-5, Little, J. C., March 14, 1956.
2. "General Ventilation - 9201-5", A Y-12 Drawing, – drawn by McAlister – 8/12/55.
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4. Catalytic Construction drawings and design notes.

FACSIMILE COVER SHEET

fan diameter?
fan location?
% cfm, N, S, roof

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

97-99%
out roof

From: E. E. Choat (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

ignore wall

Date: 7/23/96 Pages including this cover page -- 9

assume just summer

Comment:
This is to transmit the 1st draft of my final report for building 9201-5.

E. E. Choat

July 23, 1996

Ventilation Systems of Building 9201-5 as Existed in 1956

by

E. E. Choat

Building Data

- Building 9201-5 is a large process building. It's overall size is 542 feet x 312 feet. It has 3 floors and a total volume 9,471,300 ft^3. It has seven operating bays – East Crane Bay, West Crane Bay, 4 Control Bays, & 1 Service Bay.

- Figure 1 is a plan of the 3rd floor of the Colex Production Plant - 9201-5 - as it was in 1956. As seen here, "Absorbers" (a major process step) occupied the entire 3rd floor of three bays. Too, "Cascades" occupied the entire area of two very large bays. The same Cascades also occupied the 1st and 3rd floors as well. This plan is included here to provide dimensional information on the structure, to show the location of various building processes, and the location of major ventilation exhaust points.

- Figure 2 is a sectional view of the building. It is included here to provide pertinent building elevations, and to further identify the location of building processes.

- All building areas were contaminated with Mercury except the Service Area, & the Motor Generator Set Area.

Ventilation

- The initial design of the ventilation systems for this building was done by an Architect Engineering Company – Catalytic Construction Company. Supervision of this design was done by Union Carbide Plant Engineering personnel. The HVAC Design Department was responsible for review and approval of all Heating, Ventilating, and Air Conditioning (HVAC) plans, and consequently, were intimately familiar with the details of these systems. J. C. Little was then the Head of the HVAC Design Department. At that time I worked in Jim Little's department as an HVAC Design Engineer.

- Construction of this design was completed in 1955, but did not provide sufficient ventilation to maintain acceptable contamination levels.

- These systems were then modified and upgraded in 1956 in an effort to reduce contamination levels. The design was done by Union Carbide, HVAC Design Department personnel. J. C. Little, the was a major influence in these modifications.

- Subsequent to the shutdown of the Colex Production Plant in 9201-5, the building was stripped of all process equipment so that new and different processes could be installed. Ventilation systems were then modified as necessary to accommodate the requirements of the new process. During these modifications, drawings of the building ventilation systems were changed according to the new design, and consequently, no longer reflected conditions that existed in 1956.

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- flow sheet identified as "General Ventilation - 9201-5" – it has no drawing number. This document:
  1. Is a diagram of all ventilation systems of 9201-5 as of 8/12/55.
  2. Was drawn by Don McAlister – a man who worked for the HVAC Design Department.
  3. It shows three designs:
     - the original Catalytic design
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     - an upgraded ventilation design for summer operation

       Note:
       In this building, large surface areas of Mercury were exposed to the ambient air. As air temperatures increased from winter time to summer operation, more Mercury vaporized and entered the ambient. Contamination levels, then, tended to increase during the summer months. To control the contamination level, higher ventilation rates were planned for summer.

The following table reflects the total ventilation provided by the original design, and for the upgraded design. The increases in ventilation shown here seem to be consistent with operating problems that were experienced and with documented evidence of modifications that were made for improvement.

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	Winter	Summer	
Initial Design	1308545	1308545	8.3
Upgraded Design	1684410		10.7
Upgraded Design		2357755	15.9

Details of the upgraded design for winter operation are summarized in Table 1. Here all major operations have been located with respect to building column lines and building floors. Too, air supplied and exhausted are given along with volumes of spaces and air change rates.

Details of the upgraded design for summer operation are summarized in Table 2. From this, it may be observed that almost all of the building exhaust is from the 3rd floor. In fact, all is exhausted via roof fans except for 539,200 cfm that is exhausted via louvers in the East & West Crane Bays,

Table 3 is a comparison of the Catalytic Design, the Upgrade Design, and ventilation rates as reported by J.C. Little, March 14, 1956. This comparison would indicate that Little was using "Summer" ventilation rates for his study. In view of a very close agreement ~~of~~ between Little's Report and Flow Sheet Data, this comparison would indicate that both were applicable to the same period of time.

Table 1
Winter Ventilation Rates for 9201-5 Operations

								Contaminated
				Fresh Air	Air From	Room	Chgs.	Exh from
			Room	Supply	Floor Below	Exhaust	per	Building
Col	System	Floor	Volume	cfm	cfm	Cfm	Hour	cfm
4-8	Cascade 5 & 6	1	661,000	108000	0	108000	9.8	34000
4-8	Cascade 5 & 6	2	402,500	184200	74000	258200	27.5	108000
4-8	Cascade 5 & 6	3	1,209,000	130200	150200	280400	6.5	280400
						0		0
1-4	Storage	1	297,000	10000	0	10000	2.0	10000
1-4	Feed Prep	2	248,500	25000	0	25000	6.0	25000
1-4	Chem.Rec.	3	311,000	25000	0	25000	4.8	25000
						0		0
8-11	Storage	1	297,000	18000	0	18000	3.6	18000
8-11	Hang gardens &Injection	2	248,500	20000	0	20000	4.8	20000
8-11	Absorbers 5 & 6	3	374,000	115000	0	115000	18.4	115000
						0		0
11-19	Maintenance	1	842,000	80000	0	80000	5.7	
11-19	Service	2	561,500	77800	0	77800	8.3	
						0		0
19-22	Feed Storage	1	297,000	50000	0	50000	10.1	50000
19-22	Hang G. & Inj.	2	219,800	71000	0	71000	19.4	71000
19-22	Absorbers 1 & 2	3	374,000	120000	0	120000	19.3	120000
						0		0
22-26	Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	108000
22-26	Cascades 1&3 and 2&4	2	402,500	96000	0	96000	14.3	-255910
22-26	Cascades 1&3 and 2&4	3	1,209,000	236400	351910	588310	11.7	588310
						0		0
26-29	Storage	1	297,000	18000	0	18000	3.6	1200
26-29	Hang G. & Inject	2	248,000	40000	16800	56800	9.7	56800
26-29	Absorber No 3&4	3	311,000	151810	0	151810	29.3	151810
			9471300	1684410	592910		10.7	1526610
	Notes:							
	1. Air Changes based upon fresh air supplied.							

Table 2
Summer Ventilation Rates for 9201-5 Operations

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1-4	Storage	1	297,000	10000	0	10000	2.0	10000
1-4	Feed Prep	2	248,500	25000	0	25000	6.0	25000
1-4	Chem.Rec.	3	311,000	25000	0	25000	4.8	25000
						0		
8-11	Storage	1	297,000	18000	0	18000	3.6	5000
8-11	Hang gardens &Injection	2	248,500	20000	13000	33000	4.8	25600
8-11	Absorbers 5 & 6	3	374,000	275000	7400	282400	44.1	282400
						0		
11-19	Maintenance	1	842,000	80000	0	80000	5.7	
11-19	Service	2	561,500	77800	0	77800	8.3	
						0		0
19-22	Feed Storage	1	297,000	50000	0	50000	10.1	50000
19-22	Hang G. & Inj.	2	219,800	76000	0	76000	20.7	76000
19-22	Absorbers 1 & 2	3	374,000	290000	0	290000	46.5	290000
						0		0
22-26	Cascades 1&3 and 2&4	1	661,000	108000	0	108000	9.8	88000
22-26	Cascades 1&3 and 2&4	2	402,500	96000	20000	116000	14.3	120000
22-26	Cascades 1&3 and 2&4	3	1,209,000	502000	-4000	498000	24.9	498000
						0		0
26-29	Storage	1	297,000	18000	0	18000	3.6	1200
26-29	Hang G. & Inject	2	248,000	40000	16800	56800	9.7	24000
26-29	Absorber No 3&4	3	311,000	249000	32800	281800	48.0	281800
			9471300	2515555	382755		15.9	2357755

Table 3
Comparison of Flow Sheet Ventilation Rates with Those Reported by Little

			Exhaust Air Flow -- Cfm			
			From Vent. Flow Sheet			From Little
			Cat. Des.	Winter	Summer	Report
cols.	Operation	Floor				
1-4	Storage	1				
1-4	Feed Prep. & Extraction	2	35000	35000	35000	35000
1-4	Chemical Recovery	3	25000	25000	25000	25000
4-8	Cascades 5 & 6					
4-8	All Floors	1,2&3	376400	388000	555755	545000
8-11	Stores	1				
8-11	Injection Pumps 5 & 6	2	0	25600	25600	25600
8-11	Absorbers 5 & 6	3	99600	130000	290000	292000
19-22	Feed Storage	1	0	50000	50000	50000
19-22	Absorbers & Injection 1A	2	70325	71000	76000	50000
19-22	Injection Pumps 1 & 2	2	15000	50000	50000	24000
19-22	Absorbers 1 & 2	3	107110	120000	290000	292000
22-24	Cascades 1 & 3					
22-24	1st Floor		36000	44000	44000	54000
22-24	2nd Floor		8000	40000	40000	60000
22-24	3rd & 4th Floor		202000	220200	249000	257000
24-26	Cascades 2 & 4					
24-26	1st Floor		36000	44000	44000	54000
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26-29	Injection Pumps 3 & 4	2	0	24000	24000	24000
	Totals		1308545	1698850	2408465	2396600

Injection Pumps 1 & 2	22 - 26	24000	978739	0.3	293621.8	293.6218	0.65
Injection Pumps 3 & 4	26 - 29	24000	978739	0.25	244684.8	244.6848	0.54
Injection Pumps 5 & 6	8 - 11	25600	1043988	0.53	553313.9	553.3139	1.22
Chemical Recovery	1 - 4	25000	1019520	0.19	193708.8	193.7088	0.43
Feed Storage	19 - 22	50000	2039040	0.25	509760	509.76	1.12
Feed Prep. & Extraction	1 - 4	35000	1427328	0.1	142732.8	142.7328	0.31
Cascades 1 & 3	22 - 24						
1st Floor		54000	2202163	0.2	440432.6	440.4326	0.97
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.21	2200940	2200.94	4.85
Cascades 2 & 4	24 - 26						
1st Floor		54000	2202163	0.21	462454.3	462.4543	1.02
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.18	1886520	1886.52	4.16
Cascades 5 & 6	4 - 8						
All Floors		545000	22225536	0.13	2889320	2889.32	6.37
		2396600	97735265				38.31

References

1. Solvent Losses Through Ventilation Exhaust Systems, Building 9201-5, Little, J. C., March 14, 1956.
2. "General Ventilation - 9201-5", A Y-12 Drawing, – drawn by McAlister – 8/12/55.
3. Y/EX-24, Mercury at Y-12, (Unclassified version of Y/EX-21), Compiled by The 1083 Mercury Task Force, August 18, 1983.
4. Catalytic Construction drawings and design notes.

Table 4 is simply a repetition of Little's arithmetic. Input to this consist of air flow rates and concentration rates from Table 1 of Little's report. Other columns are simply details of the calculation. The resulting lbs/day effluent are the same as reported – of course.

Table 4
Validation of Little's Arithmetic

	building	Exhaust		Concentration			
	col. lines	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day
Absorbers 1 & 2	19 - 22	292000	11907994	0.18	2143439	2143.439	4.73
Absorbers 3 & 4	26 - 29	292000	11907994	0.18	2143439	2143.439	4.73
Absorbers 4 & 5	8 - 11	292000	11907994	0.12	1428959	1428.959	3.15
Absorbers & Injection 1A	19 - 22	50000	2039040	0.28	570931.2	570.9312	1.26
Injection Pumps 1 & 2	22 - 26	24000	978739	0.3	293621.8	293.6218	0.65
Injection Pumps 3 & 4	26 - 29	24000	978739	0.25	244684.8	244.6848	0.54
Injection Pumps 5 & 6	8 - 11	25600	1043988	0.53	553313.9	553.3139	1.22
Chemical Recovery	1 - 4	25000	1019520	0.19	193708.8	193.7088	0.43
Feed Storage	19 - 22	50000	2039040	0.25	509760	509.76	1.12
Feed Prep. & Extraction	1 - 4	35000	1427328	0.1	142732.8	142.7328	0.31
Cascades 1 & 3	22 - 24						
1st Floor		54000	2202163	0.2	440432.6	440.4326	0.97
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.21	2200940	2200.94	4.85
Cascades 2 & 4	24 - 26						
1st Floor		54000	2202163	0.21	462454.3	462.4543	1.02
2nd Floor		60000	2446848	0.26	636180.5	636.1805	1.40
3rd & 4th Floor		257000	10480666	0.18	1886520	1886.52	4.16
Cascades 5 & 6	4 - 8						
All Floors		545000	22225536	0.13	2889320	2889.32	6.37
		2396600	97735265				38.31

References
1. Solvent Losses Through Ventilation Exhaust Systems, Building 9201-5, Little, J. C., March 14, 1956.
2. "General Ventilation - 9201-5", A Y-12 Drawing, – drawn by McAlister – 8/12/55.
3. Y/EX-24, Mercury at Y-12, (Unclassified version of Y/EX-21), Compiled by The 1083 Mercury Task Force, August 18, 1983.
4. Catalytic Construction drawings and design notes.

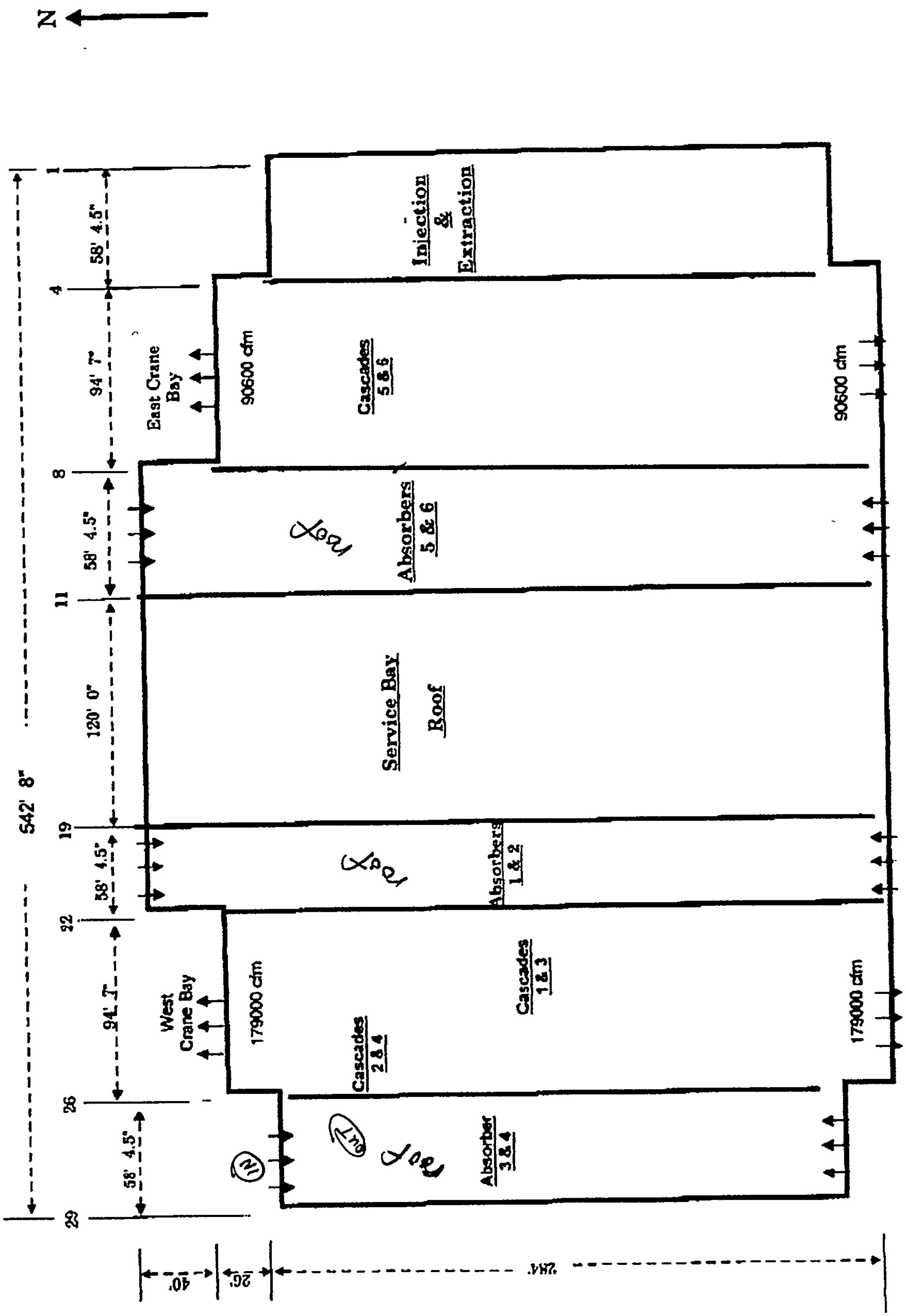
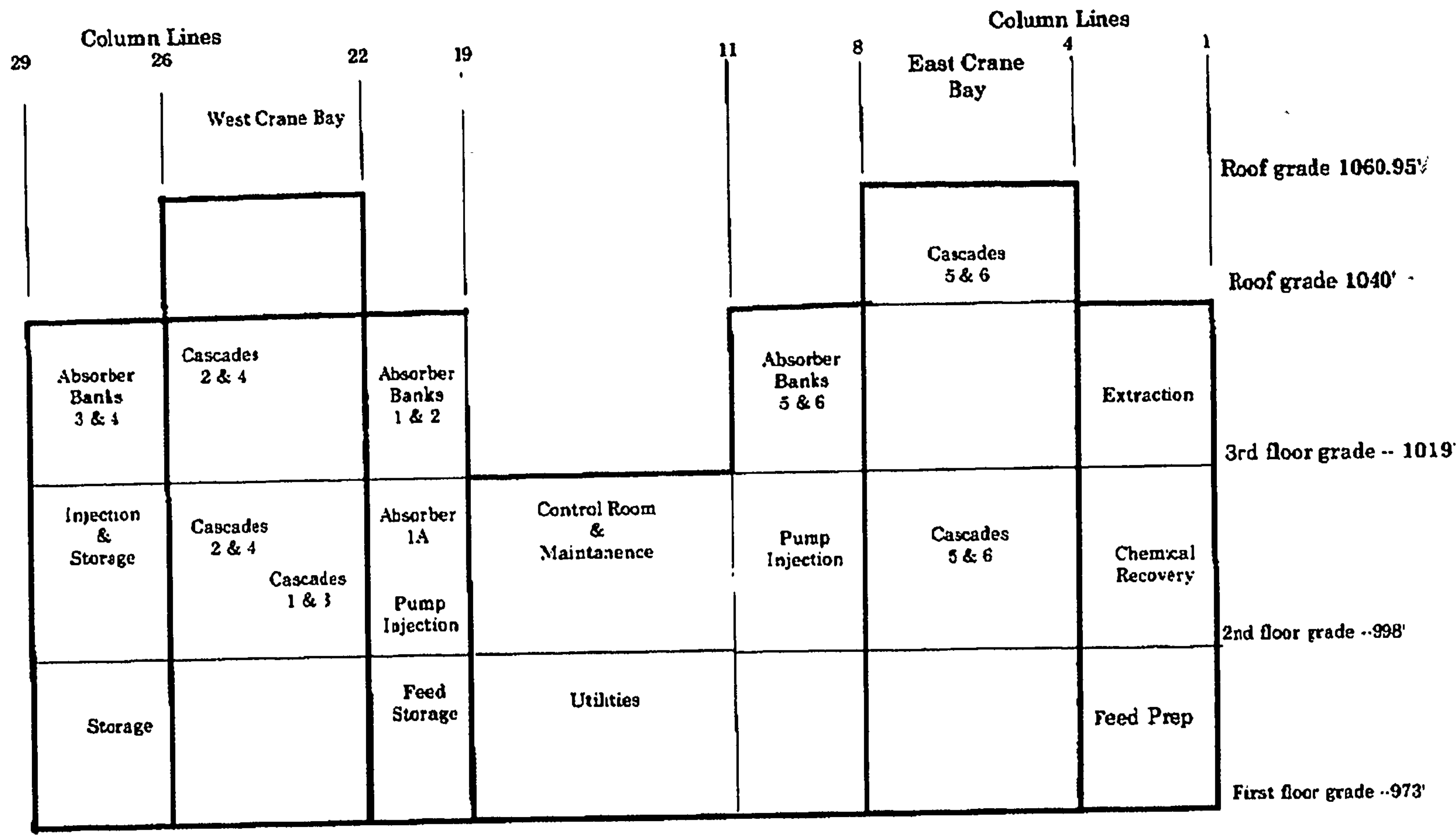


Figure 1
3rd Floor Plan -- Building 9201-5

Figure 2
Section A - A ---- Building 9201-5



July 30, 1996

Ventilation Systems of Building 9201-4
as Existed in 1956
by
E. E. Choat

Building Data

- Building 9201-4 is a large process building. It's overall size is ~~542~~ 543 feet x 312 feet. It has 3 floors and a total volume 9,471,300 ft^3. It has seven operating bays – East Crane Bay, West Crane Bay, 4 Control Bays, & 1 Service Bay.

350 x

- During the time of the Colex Production Plant, the two major steps of process operations were identified as "Cascades", & "Absorbers". Cascades occupied all three floors of the East & West Crane Bays. Absorbers were located on the third floor of all four Control Bays. All building areas were contaminated with Mercury except for the Service Area, & Motor Generator (MG) Set Areas. and Maintenance?

For this study, a set of simplified building plans have been reconstructed for the purpose of describing characteristics of the building and to illustrate the ventilation systems that were installed in 1956. These plans are included in this report as:

Figure 1 – 1st Floor Plan
Figure 2 – 2nd Floor Plan
Figure 3 – 3rd Floor Plan
Figure 4 -- Section A - A – Building 9201-4

These plans are intended to show the location of various building processes, the location of major exhaust systems, and to provide dimensional information on the structure.

Ventilation

- Initial design was done by an Architect Engineering Company – Catalytic Construction Company. In general, 100 % outside air was supplied from the basement and exhausted via the 3rd floor walls and roof. Construction of this design was completed in 1955 but did not provide sufficient ventilation to maintain acceptable contamination levels.

These systems were then modified and upgraded in 1956 in an effort to reduce contamination levels. The design was done by Catalytic Construction Company. Because of an increased vaporization of Mercury as temperature increased, more ventilation was provided in

Figure 1
"1st Floor Plan" -- Building 9201-4

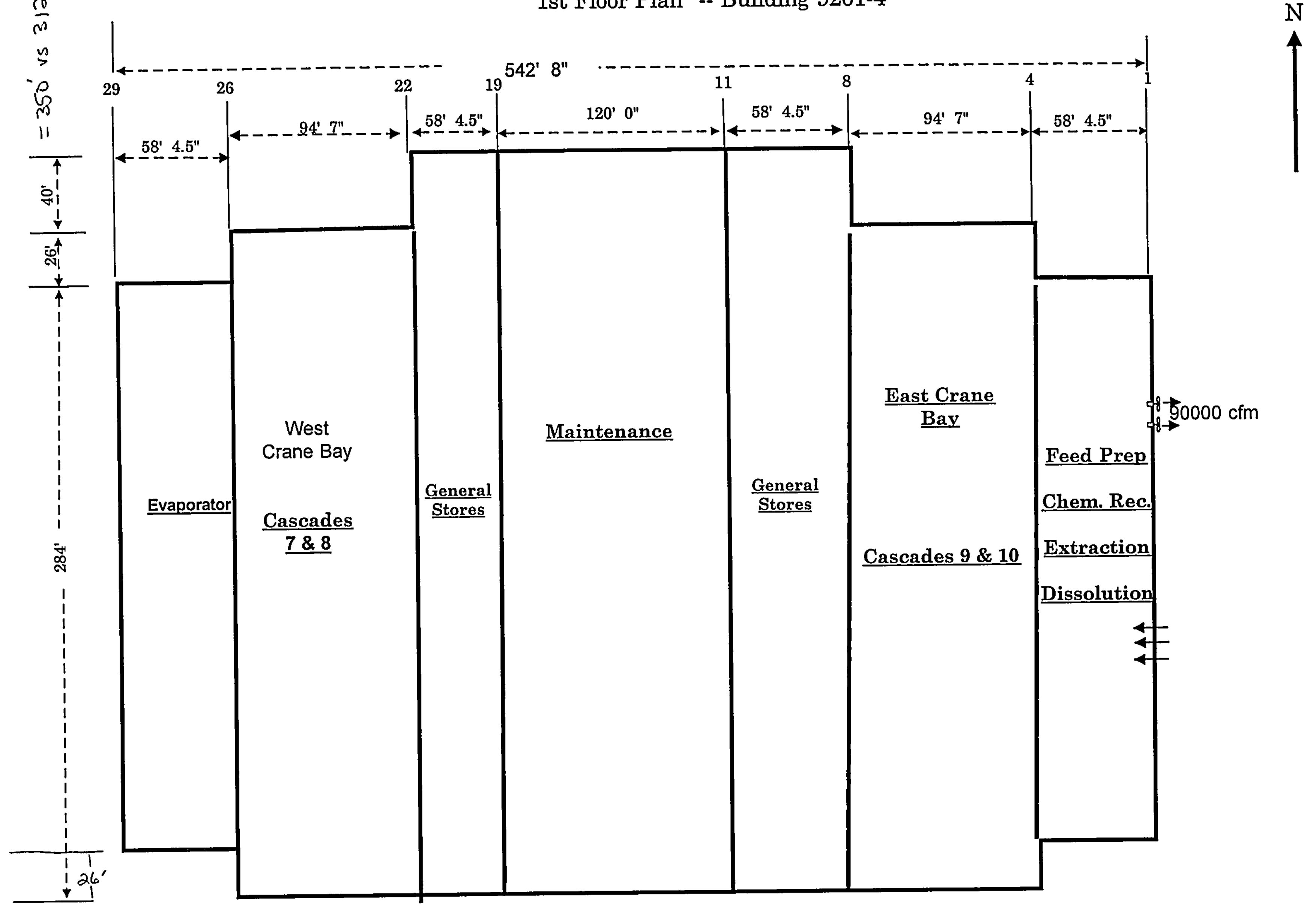


Figure 2
"2nd Floor Plan" -- Building 9201-4

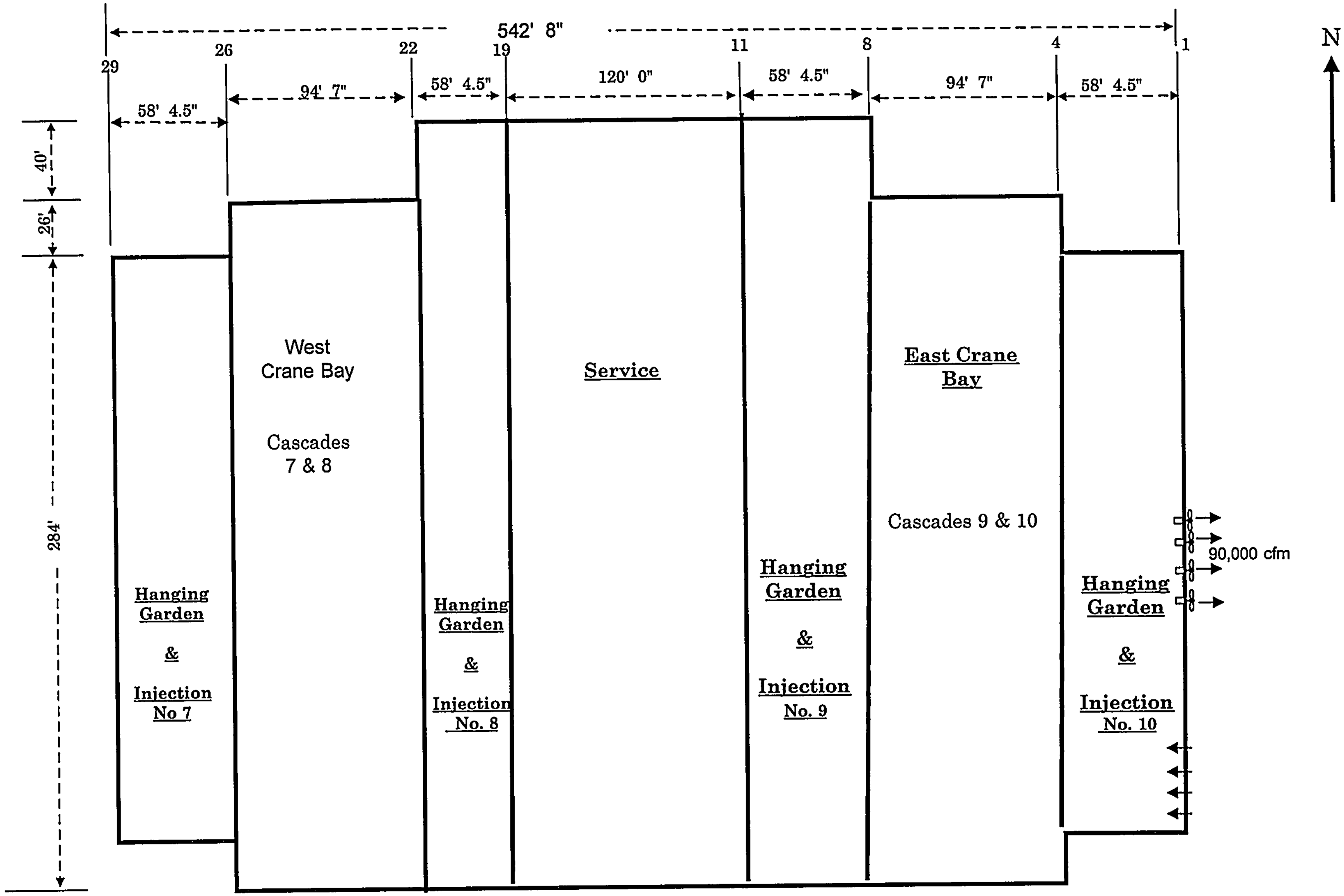


Figure 3
"3rd Floor Plan" -- Building 9201-4

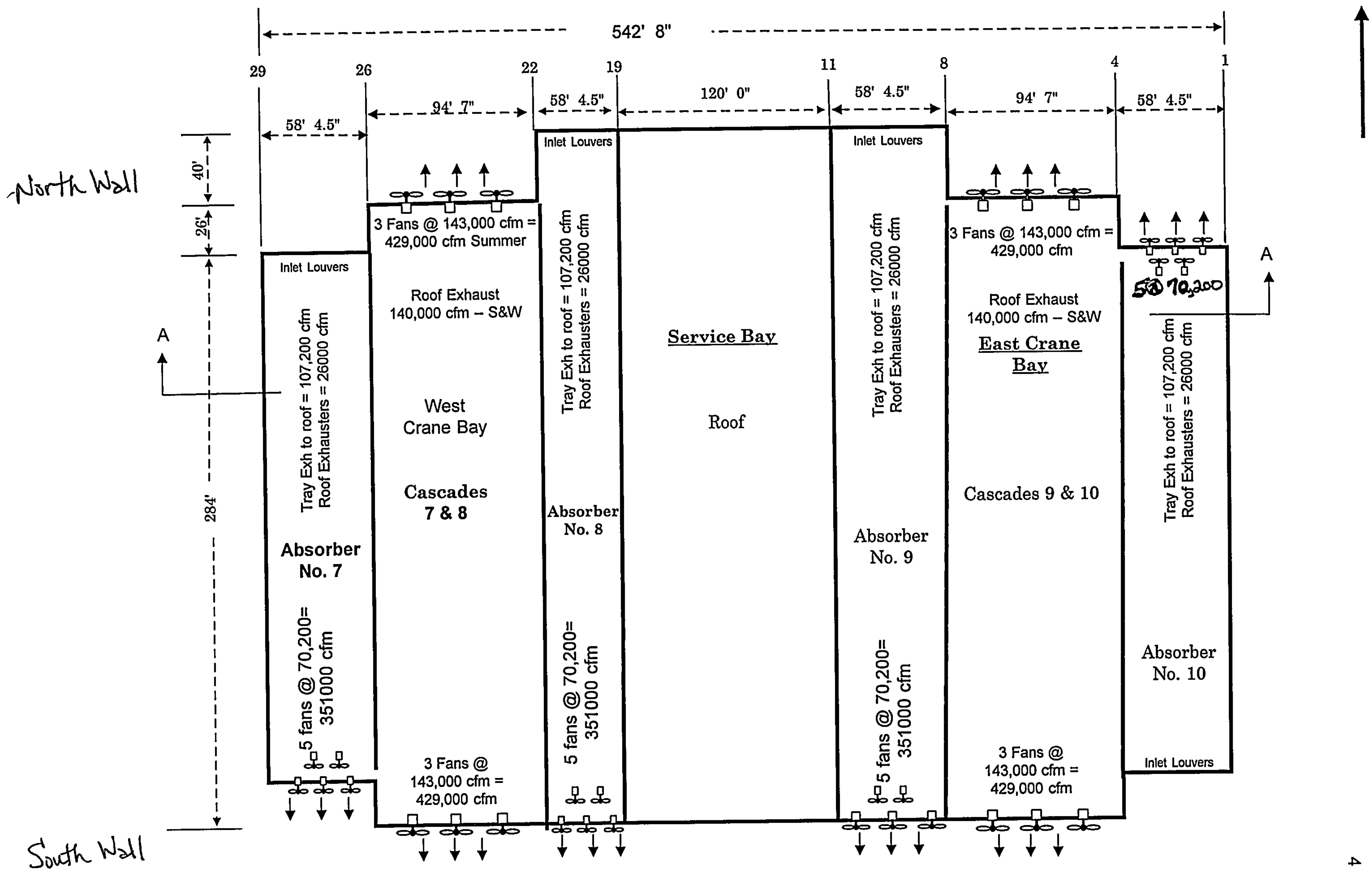
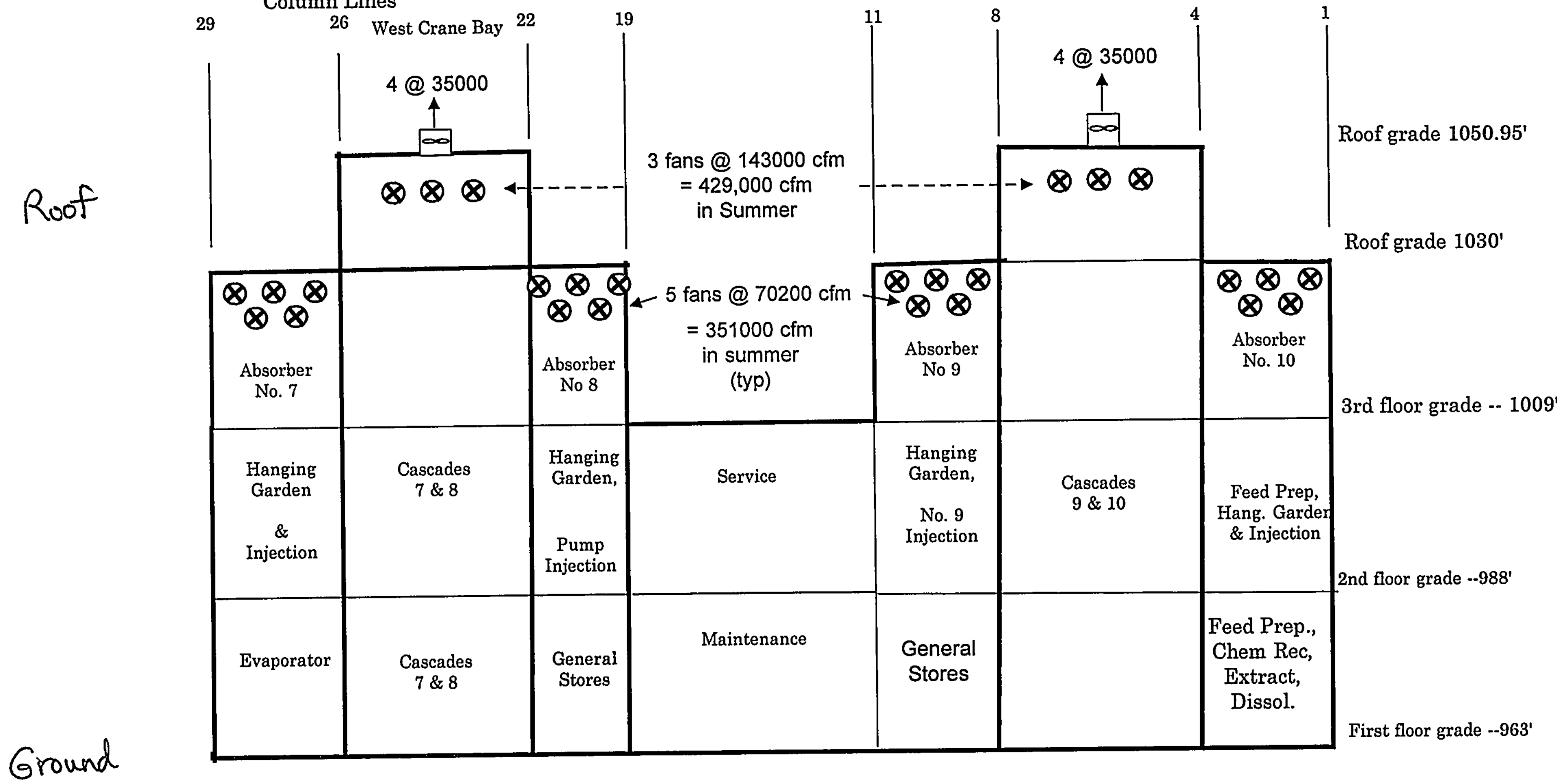


Figure 4
Section A - A (Looking North)---- Building 9201-4



summer than in winter. Consequently, design documents and this report often refer to both.

Table 1 is a summa~~rization~~y of the findings of this study regarding the "Winter" Ventilation design for 9201-4. Recorded here are:

1. Identities of all process areas of the Colex Production Plant

Table 1
Winter Ventilation Design for 9201-4

ft.	Col	System	Floor	Room Volume	Fresh Air Supply cfm	Air From Floor Below cfm	Room Exhaust Cfm	Chgs. per Hour	Contaminated Exh from Building cfm
310'x95'x22'	4-8	Cascade 9 & 10	1	661,000	270510	0	270510	24.6	52000
14'	4-8		2	402,500	181400	218510	399910	27.0	48000
41'	4-8		3	1,209,000	275000	351910	626910	13.6	626910
							-0-		-0-
258x58x20'	1-4	Chem.Rec., Feed Prep	1	297,000	93500	0	93500	18.9	93500
16	1-4	Hang Garden & Inj 10	2	248,500	129990	0	129990	31.4	129990
21	1-4	Absorber No. 10	3	311,000	151810	0	151810	29.3	151810
							-0-		-0-
350x58x 14	8-11	General Stores	1	297,000	27000	0	27000	5.5	5110
12	8-11	Hang gardens & Inj 9	2	248,500	34410	21890	56300	8.3	56300
18	8-11	Absorber No. 9	3	374,000	151810	0	151810	24.4	151810
							-0-		-0-
[illegible] x120x20	11-19	Maintenance	1	842,000	80000	0	80000	5.7	0
13	11-19	Service	2	561,500	77800	0	77800	8.3	0
							-0-		-0-
350x58x 14	19-22	General Stores	1	297,000	27000	0	27000	5.5	940
11	19-22	Hang G. & Inj. #~~9~~8	2	219,800	34410	26060	60470	9.4	60470
18	19-22	Absorber # 8	3	374,000	151810	0	151810	24.4	151810
							-0-		-0-
310x95x22	22-26	Cascade 7 & 8	1	661,000	270510	0	270510	24.6	52000
14	22-26		2	402,500	181400	218510	399910	27.0	48000
41	22-26		3	1,209,000	275000	351910	626910	13.6	626910
							-0-		-0-
258x58x 20	26 -29	Evaporator	1	297,000	38010	0	38010	7.7	38010
17	26-29	Hang G. & Inject 7	2	248,000	32000	0	32000	7.7	32000
21	26-29	Absorber No 7	3	311,000	151810	0	151810	29.3	151810
				9471300	2635180	1188790		16.7	2477380 ✓ O.K.

2,836,000 cfm 1/EX-21

2. Location of all process areas within the building. For example - Cascades 9 & 10 occupied all three floors between column lines 4 & 8.
3. Room volume of all process compartments
4. Fresh air supplied to each compartment
5. Air transferred between floors
6. Total Room Exhaust – it's the sum of air supplied and air transferred from another floor.

2nd avg 3.59 M cfm

7. Changes per hour – It's a commonly used term to describe ventilation rates. Mathematically, it is equal to cfm x 60 – or cubic feet per hour – divided by the room volume. For this design the fresh air volumes were used for calculations (i.e., air transferred between floors was not included)
8. Contaminated exhaust from the building – it's the air volume exhausted directly to outside. In this design, this air stream was sometimes exhausted via a duct system to the roof. In other instances is was exhausted via propeller fans mounted in the wall at the 3rd floor elevation.

WHY? all counts fresh and used air

It should be noted that the ventilation systems for the Motor Generator (MG) Sets are not included in this table as these areas are not considered to be contaminated. Too, air exhausted from the Maintenance and Service areas are not included in the total ~~C~~ontaminated ~~E~~xhaust from the ~~B~~uilding.

Table 2 is a summar~~ization~~y of the ventilation design for "Summer" operation.

Table 2
Summer Ventilation Design for 9201-4

Col	System	Floor	Room Volume	Fresh Air Supply cfm	Air From Floor Below cfm	Room Exhaust Cfm	Chgs. per Hour	Exh from Building cfm
4-8	Cascade 9 & 10	1	661,000	297560	0	297560	27.0	48000
4-8	Cascade 9 & 10	2	402,500	199540	249560 ✓	449100	29.7	48000
4-8	Cascade 9 & 10	3	1,209,000	591775	401100 ✓	992875	29.4	992875
						-0-		-0-
1-4	Chem.Rec., Feed Prep	1	297,000	154350	0	154350	31.2	154350
1-4	Hang Garden & Inj 10	2	248,500	189990	0	189990	45.9	189990
1-4	Absorber No. 10	3	311,000	478210	0	478210	92.3	478210
						-0-		-0-
8-11	General Stores	1	297,000	29700	0	29700	6.0	5620
8-11	Hang gardens & Inj 9	2	248,500	37850	24080	61930	9.1	61930
8-11	Absorber No. 9	3	374,000	478210	0	478210	76.7	478210
						-0-		-0-
11-19	Maintenance	1	842,000	80000	0	80000	5.7	0
11-19	Service	2	561,500	77800	0	77800	8.3	0
						-0-		-0-
19-22	General Stores	1	297,000	29700	0	29700	6.0	1040
19-22	Hang G. & Injection #8	2	219,800	37850	28660	66510	10.3	66510
19-22	Absorber # 8	3	374,000	478210	0	478210	76.7	478210
						-0-		-0-
22-26	Cascade 7 & 8	1	661,000	297560	0	297560	27.0	48000
22-26	Cascade 7 & 8	2	402,500	199540	249560	449100	29.7	48000
22-26	Cascade 7 & 8	3	1,209,000	591775	401100	992875	29.4	992875
						-0-		-0-
26-29	Evaporator	1	297,000	97810	0	97810	19.8	97810
26-29	Hang G. & Inject 7	2	248,000	35200	0	35200	8.5	35200
26-29	Absorber No 7	3	311,000	478210	0	478210	92.3	478210
			9471300	4860840	1354060		30.8	4703040 ✓ O.K.

2,836,000 cfm

1,526,610

Observations

1. Contrary to assumptions of previous studies, the ventilation systems for 9201-4 are not the same as 9201-5. From this study, the total contaminated air exhausted from these buildings was:

	Winter		Summer	
	Cfm	Air Changes	Cfm	Air Changes
9201-5	~~1684410~~ ✓	10.7	2357755✓	15.9
9201-4	2477380✓	16.7	4703040✓	30.8

Previous reports of ~~M~~ mercury loss to the atmosphere via the building exhaust systems has been based upon the assumption that ventilation systems of 9201-4 were essentially the same as 9201-5. Since this study has indicated a considerable difference in contaminated air exhausted, a new estimate has been made for ~~M~~ mercury loss to the atmosphere for the period of the 2nd quarter of 1955 through the 4th quarter of 1962. The results of these calculations are ~~exhibited~~ presented in Table 3. Assumptions were:

1. Winter ventilation rates apply for the 1st & 4th quarters.
2. Summer ventilation rates apply for the 2nd & 3rd. quarters.
3. Mercury concentrations were as reported in "Wilcox", page 111.

For comparison, losses reported in the "Wilcox" report are printed alongside these calculations. Since actual exhaust air flows in 9201-4 were much higher than previously presumed, this calculation indicates that the total loss may have been ~~nearer 32382 vs~~ closer to 33262 lbs. rather than 18447 lbs.

Table~~s~~ 4 is a summary of all contaminated air exhaust systems of 9201-4 for "summer" operation. This is a listing of exhaust fans, fan sizes, fan capacity in cfm, outlet velocities, orientation, and elevations.

Table 4
A Building Exhaust System Summary – for Summer

1051+

		Fan (in.)	Area	Cfm	(fpm)	direction		Total	%
Exhaust Location	No	Dia.	sq. ft.	Each	Velocity		elev	cfm	
Cascade Roof Exh.	8	54	15.90	35000	2200	up	1050	280000	6%
Tray Exhaust	4	--	--	107200	2200	up	1050	428800	9%
Roof Exhausters	4	--	--	26000	2200	up	1050	104000	2%
From 1 & 2nd Floor	8	--	--	--	2200	up	1050	590240	13%
Roof Total								1,403040	30%
South Wall- Absorbers	15	72	28.27	70200	2483	horiz	1020	1053000	22%
South Wall - Cascades	6	108	63.62	143000	2248	horiz	1020	858000	18%
South Wall Total								1,911000	41%
North Wall- Absorbers	5	72	28.27	70200	2483	horiz	1020	351000	7%
North Wall - Cascades	6	108	63.62	143000	2248	horiz	1020	858000	18%
North Wall Total								1,209000	26%
2nd Floor -- East	4	42	9.62	22500	2339	horiz	1000	90000	2%
1st Floor -- East	2	60	19.64	45000	2292	horiz	980	90000	2%
1st and 2nd Floor Total								180,000	4%
Total of All Exhaust								4,703040	100%

all ✓ OK ✓ OK

centrifugal

duct propeller

Area

$\frac{107200}{2200}$

$\frac{26000}{2200}$

$\frac{590240}{2200} \div 8$

$\frac{ft^3/min}{ft/min}$

Table 5 is a ~~scenario~~ summary of winter operation of ventilation exhaust systems in 9201-4. Here exhaust air volumes were reduced by turning off certain fans. In Table 5, the number of fans has been reduced as compared to those given in Table 4 to simulate the winter operation.

$\pi d^2/4$

Table 5
A Building Exhaust System Summary – for Winter

		Fan (in.)	Area	Cfm	ft/min = fpm		ft	Total	%
Exhaust Location	No	Dia.	sq. ft.	Each	Velocity	direction	elev	cfm	
Cascade Roof Exh	8	54	15.90	35000	2200	up	105~~6~~	280000	11
Tray Exhaust	4	- -	-	107200	2200	up	105~~6~~	428800	17
Roof Exhausters	4	--	--	26000	2200	up	105~~6~~	104000	4
From 1 & 2nd Floor	--	--	--		2200	up	105~~6~~	591380	24
Roof Total								1404180	57%
South Wall- Absorbers	4/15	72	28.27	70200	2483	horiz	1020	280800	11
South Wall - Cascades	2/6	108	63.62	143000	2248	horiz	1020	286000	12
S. Wall Total								566800	23%
North Wall- Absorbers	2/5	72	28.27	70200	2483	horiz	1020	140400	6
North Wall - Cascades	2/6	108	63.62	143000	2248	horiz	1020	286000	11
N. Wall Total								426400	17%
2nd Floor -- East	2/4	42	9.62	22500	2339	horiz	1000	40000	2%
1st Floor -- East	1/2	60	19.64	45000	2292	horiz	980	40000	2%
Total of All Exhaust								2477380	100%

1st and 2nd Total

4%

OK

As seen in Tables 4 & 5, contaminated building exhaust was predominantly from the roof fans and through the walls at the 3rd floor level. In summary:

	Summer			Winter	
	Cfm	elevation	%	cfm	%
Roof	1403040	105~~6~~	30	1404180	57%
South Wall-- 3rd Floor	1911000	1020	41	566800	23%
North Walls – 3rd Floor.	1209000	1020	26	426400	17%
East Wall – 2nd Floor	90000	1000	2	40000	2%
East Wall – 1st Floor	90000	980	2	40000	2%

Direction
up
south - horiz.
north - horiz
east - horiz

annual avg
30% 43.5% 57%
41 32 23
26 21.5 17
4 4 4
100

more dates?

References:

1. General Ventilation Study – Bldg. 9201-4 – design notes
2. Building 9201-4 – 4 Tray Rooms – design sketch
3. Proposed Cascade Ventilation – design sketch
4. Proposed Absorber Ventilation – design sketch
5. McAlister, Don, General Ventilation- Bldg. 9201-4, 8/15/55 – design sketch
6. EM-708 through EM-729, Master Plan Drawings completed 1970. These are believed to represent As-Built conditions for the Colex Production Project. Since this building has not been modified since shut-down, these drawings should be an accurate record of 9201-4 ventilation systems of 1996 as well.
7. Catalytic Construction Company's Ventilation Flow Sheets
8. Catalytic Construction Company's Construction Drawings

July 27, 1996

Q: No differences for Summer vs. Winter? see p.5

Ventilation Systems of Building 9204-4 as Existed in 1953

by

E. E. Choat

Building Data

Figure 1 is a partial plan of the 2nd floor and a sectional view of building 9204-4 that is believed to be the building space occupied by the Elex Production Plant during the early 1950's. Elex occupied essentially all of the space between column lines 1 - 43, and F - J. It represents an area of 34,226 ft^2 and a building volume of 1,745,550 ft^3.

when?

*SMF Need some history/dates added here.

Subsequent to the shutdown of the Elex Production Plant, the building was stripped of all process equipment so that new and different processes could be installed. Ventilation systems were then modified as necessary to accommodate the requirements of the new process. During these modifications, drawings of the building ventilation systems were changed according to the new design, and consequently, no longer reflected conditions that existed in 1952 - 55.

For this study, it has been necessary to search through existing drawings and documentation for sufficient information to reconstruct a model of the ventilation systems which existed in early fifties.

Phase ~~1~~ I Ventilation

The initial design for this plant was done by the Vitro Corporation, and provided for 554,400 cfm of exhaust. This volume of air in the space occupied by the Elex Plant resulted in an air change rate of 19 changes per hour.

Building exhaust is thought to have been by three modes as follows:

"X" g/d 1. Nine (9) Roof Ventilators --- 194,400 cfm

1g/d 2. Two (2) Exhaust Stacks --- 120,000 cfm

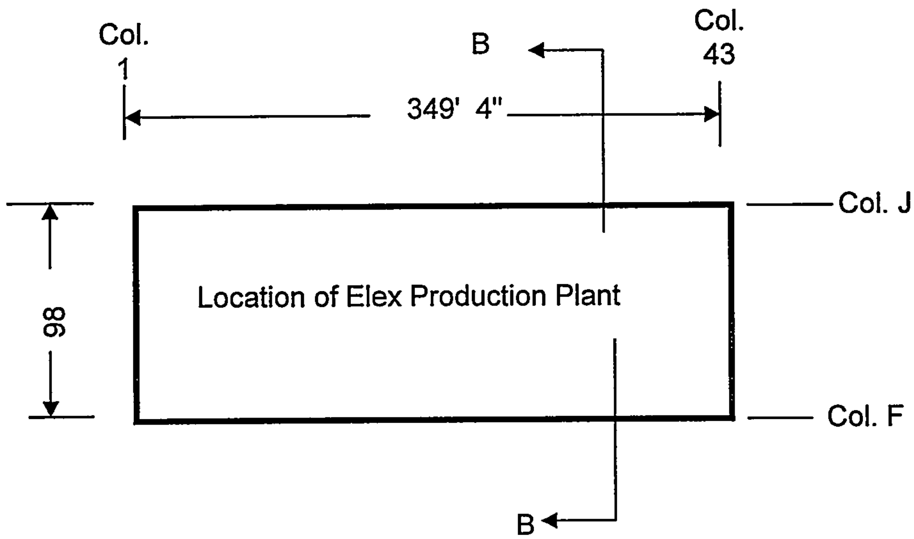
(7.6-X) g/d 3. Six (6) Propeller Fans – mounted in the walls – 240,000 cfm

554,400

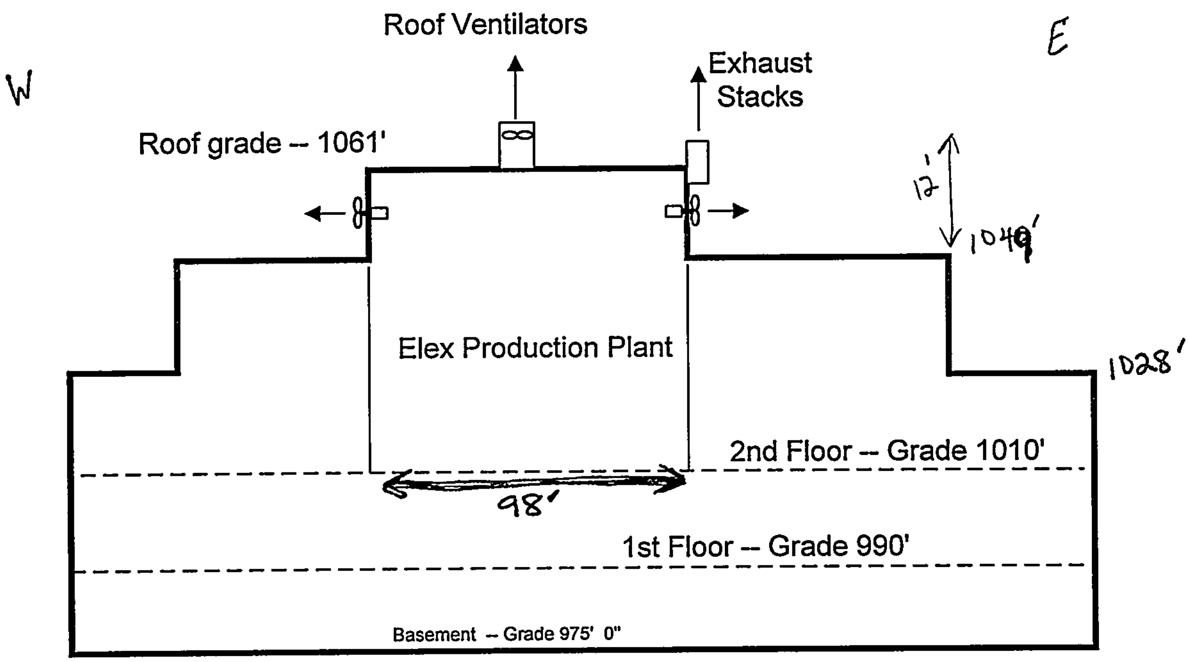
The location of these exhaust points is illustrated in Section B - B of Figure 1. They were also shown on Vitro drawing 50-K2-10. This drawing has been superseded by subsequent design changes and is now identified as Catalytic drawing B-32147. Master ~~P~~ plans of this building, completed in 1985, show these fans as still existing at that time.

Except for the two fans that exhausted to stacks, the sizes, air volume capacity, and outlet are summarized in Table 1. The two unidentified fans are believed to have been ~~2 centrifugal fans located on the 1st floor fan room on the North side of the building~~. ~~These fans exhausted to stacks which extended up the outside wall to an elevation above the roof.~~

Figure 1
Plan and Sectional View of Elex Production Plant --- Building 9204-4



Partial Plan of 2nd Floor
Building 9204-4 -- grade 1010'



~~Eleva~~tion B-B
Sec

Table 1
Exhaust Fans Provided for Elex Production Plant – Phase 1

		Air Volume Cfm	Fan size Inches	Outlet Area - ft²	Outlet Velocity Fpm			
10	Roof Ventilator	20000	36	7.07 ✓	2829			
11	Roof Ventilator	20000	36	7.07	2829	Reference:		
12	Roof Ventilator	24800	36	7.07	3508	Calalytic drawing B-32147.		
13	Roof Ventilator	20000	36	7.07	2829	Issue date 11/6/53. Includes		
14	Roof Ventilator	24800	36	7.07	3508	as built work under contract 40011.		
15	Roof Ventilator	20000	36	7.07	2829	Supersedes Vitro Dwg. 50-K2-10.		
16	Roof Ventilator	24800	36	7.07	3508			
17	Roof Ventilator	20000	36	7.07	2829			
18	Roof Ventilator	20000	36	7.07	2829			
	Exh. to Stack	60000	72 x 72	36.00	1667	Believed to be systems cited W.		
	Exh. to Stack	60000	72 x 72	36.00	1667	Brumann report to W. K. Whitson,		
K-10905-1	Prop Fan - wall	40000	60	19.64	2037	10/28/53.		
K-10905-2	Prop Fan - wall	40000	60	19.64	2037			
K-10905-3	Prop Fan - wall	40000	60	19.64	2037			
K-10905-4	Prop Fan - wall	40000	60	19.64	2037	See Vitro dwg. 86-K2-5		?
K-10905-5	Prop Fan - wall	40000	60	19.64	2037	CFC 1953 - Jasny		
K-10905-6	Prop Fan - wall	40000	60	19.64	2037			
		554400						
				A total Exhaust of **554400** cfm correlates				
				well with 538,~~000~~ predicted from Brumann				
6/2/96				report.	453			
E. E. Choat								

1061' up ↓

1061' up

1061' up

horiz. ↓

43?

The magnitude of exhaust ventilation provided in the initial design may also be extracted from W. Brumann's report to W. K. Whitson[1]. In this report, air sampling was done for 2 exhaust systems having a capacity of 60000 cfm. At the concentrations reported for the North Plant, this volume of air would result in 0.86 pounds of mercury per day being delivered to the environment. But, the report stated that 3.8 pounds was lost. Therefore, 60000 cfm must have been only a part of the total air exhausted. The total air volume required to deliver 3.8 pounds to atmosphere at the concentrations given, is 264,167 cfm. This calculation along with air flows and concentrations from the Brumann report is shown in Table 2.

2nd pg.

[1] W. Brumann, Industrial Hygiene Section, to W. K. Whitson, 10/28/53.

Table 2
Estimated Elex Exhaust from Brumann Report[1]

10/28/53 Exhaust

Also bldg avg. have four concs for 1955-59 (use 1,054,000 cfm for these) (6-10) these concs are lower than the 10-28-53 ones

	Exhaust		Concentration			10/28/53	8.6 lbs/d	
Sample	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day		
1	7500	305856	0.14	42819.84	42.81984	0.09		
2	7500	305856	0.14	42819.84	42.81984	0.09		
3	7500	305856	0.12	36702.72	36.70272	0.08		
4	7500	305856	0.15	45878.4	45.8784	0.10		
5	7500	305856	0.22	67288.32	67.28832	0.15		
6	7500	305856	0.2	61171.2	61.1712	0.13		
7	7500	305856	0.15	45878.4	45.8784	0.10		
8	7500	305856	0.16	48936.96	48.93696	0.11		
Total	60000	2446848		391495.7	391.4957	0.86		
Average Concentration Reported = .16								
Total Reported Solvent Loss from the North Plant = ~~3.8 lbs~~						For this total loss, air flow		
must be 3.8/.86309 higher. Then, Cfm = 60000*3.8/0.86309							Cfm =	264167 ✓
						10/28/53		
? N. Plant Total	265000	10806912	0.16	1729106	1729.106	3.81	agrees with report	
Sample			10/28/53					
9	7500	305856	0.22	67288.32	67.28832	0.15		
10	7500	305856	0.22	67288.32	67.28832	0.15		
11	7500	305856	0.21	64229.76	64.22976	0.14		
12	7500	305856	0.21	64229.76	64.22976	0.14		
13	7500	305856	0.19	58112.64	58.11264	0.13		
14	7500	305856	0.17	51995.52	51.99552	0.11		
15	7500	305856	0.16	48936.96	48.93696	0.11		
16	7500	305856	0.18	55054.08	55.05408	0.12		
Total	60000					1.05		
Average Concentration Reported = .0.20								
Total Reported Solvent Loss from the South Plant = ~~4.8 lbs.~~						For this total loss, air flow		
must be 4.8/1.05 higher. Then, Cfm = 60000*4.8/1.05.							Cfm =	274286 ✓
	×40.7808		×		× 10^{-3}	÷ 453.5		
? S. Plant Total	265000	10806912	0.2	2161382	2161	4.76	agrees with report	
Total Building Exhaust is estimated to be = 274,286 + 264167						=	538453 ✓	
5/8/96 — Today I talked with Bill Whitson. ~~He is 82 now and not well.~~ He thinks that the								
wall fans proposed in 1954 were installed.								
5/14/96 – Talked to Glenn Kitchings – draftsman on B-4 master plans. ~~He is now working at Downtown Hardware.~~								

He thinks that the wall fans proposed in 1954 were installed.

240,000
+194,400
434,400
÷ 2
217,200
≈ 265,000

In the same manner, total air flow from the South Plant was calculated as being 274,286 cfm. The sum of North plant exhaust and South plant exhaust

---

1

is equal to 538,453 cfm which is only 3% less than values shown on the drawings. ✓

Phase II Ventilation

Additional ventilation of the Elex Plant is believed to have been installed in the later months of 1954. In a letter -- to Mr. R. C. Armstrong, USAEC from J. P. Murray, Y-12 Plant Superintendent – of 7/15/54, it was noted that contamination levels were too high. This letter also recommended 500,000 cfm of additional ventilation. This was to be accomplished with additional propeller fans installed in walls around the cascade.

I believe that this proposal was implemented for the following reasons:

1. I have talked to two people (W.K. Whitson and Glenn Kitchings) who were employees in the 9204-4 building during the time of Elex, and they both think that this plan was implemented.

2. Also, Martin Maritta drawings H2E002078MP & H2E002079MP – show 16 fans installed in the walls along columns F & J. These drawings are from the "Master Plan" series, dated 5/8/85. Six of these fans are the same as those shown in the original design by Vitro. The other 10 are believed to be those referenced in the Armstrong letter. These ten fans of a moderate size could have easily provided the 500,000 cfm cited. I believe this air volume to be near that installed, as it was noted that the fans were "on hand" in Y-12.

With an additional exhaust of 500,000 cfm, the air change rate during the summer operation of the Elex Production Plant would have been 36 changes per hour. ✓

References

4. W. Baumann, Industrial Hygiene Section, to W.K. Whitson, 10/28/53.
5. J.P. Murray, Y-12 Plant Manager, to R.C. Armstrong, USAEC, 7/12/54.
6. W.K. Whitson, personal communication with E.E. Chost, 5/8/96.
7. Glenn Kitchings, personal communication with E.E. Chost, 5/14/96.

1. Vitro Corp. drawing 50-K2-10 (For Bldg. 9204-4) Date = ?
2. Catalytic Construction drawing B-32147 OK. Date = 11-6-53
3. Martin Marietta master plan drawing series, 5-8-85.

Bldg ventilation was increased 50% in summer starting in 1955.

Yr/ Qtr		lbs stack *	lbs air	lbs H2 gas	lbs used for modeling	
1953 3Q	45 d only	380.7	~~NR (est'd) #~~ 142.4 ~~86~~	294.7	380.7	
				589.4		
1953 4Q	90 d	761.4	122.1	639.3	761.4	
Total						1142.1
1954 1Q		761.4	81.4	680.0	761.4	
1954 2Q		761.4	203.5	557.9	761.4	
1954 3Q		761.4	142.4	619.0	761.4	
1954 4Q		761.4	122.1	639.3	761.4	
Total						3045.6
1955 1Q		761.4	162.8	598.6	761.4	
1955 2Q	ventln incrd	1142.1	511.8	630.3	1142.1	
1955 3Q	ventln incrd	1142.1	597.1	545.0	1142.1	
1955 4Q		761.4	269.2	492.2	761.4	
Total						3807.0
1956 1Q		761.4	314.1	447.3	761.4	
1956 2Q	stripping bldg	NA	426.5	NA	426.5	
1956 3Q	stripping bldg	NA	511.8	NA	511.8	
1956 4Q	stripping done	NA	NR	NA	0.0	
Total						1699.7
1957		NA	NR	NA		0.0
1958 1Q	B-4 extract		NR		0.0	
1958 2Q			767.7		767.7	
1958 3Q			511.8		511.8	
1958 4Q			179.5		179.5	
Total						1459.0
1959 1Q	B-4 extract		134.6		134.6	
1959 2Q			341.2		341.2	
1959 3Q			170.6		170.6	
1959 4Q			269.2		269.2	
Total						915.6
				avg		
Total			5839.4	585.3	12069.0	

Notes: * based on 8.46 lb/d in exhuast air measured in October 1953.

~~# 1953 3Q lbs were estimated by using the avg lbs released per qtr for pre-1955 and post-1955 winters 173 lbs x (45d / 90d), or 0.5) = 86.~~

NA = not applicable (H2 gas emissions during process operations only)

Calculation of Pounds of Mercury Exhausted to Atmosphere per Quarter from Building 9204-4										
Year	Quarter	Exhaust		Hg Conc	Effluent					
		cfm	m3/day	mg/m3	mg/day	g/day	lbs/day	lbs/qtr	lbs/yr	Comments
1953	1									
	2									
45 d only	3			.07				142.4		
	4	554,400	22609345.8	0.06	1356560.75	1356.561	1.356561	122.1		
									~~122.1~~	264.5
1954	1	554,400	22609345.8	0.04	904373.83	904.3738	0.904374	81.4		
	2	554,400	22609345.8	0.1	2260934.58	2260.935	2.260935	203.5		
	3	554,400	22609345.8	0.07	1582654.21	1582.654	1.582654	142.4		
	4	554,400	22609345.8	0.06	1356560.75	1356.561	1.356561	122.1		
									549.4	
1955	1	554,400	22609345.8	0.08	1808747.66	1808.748	1.808748	162.8		
	2	1,054,000	42983857.3	0.06	2579031.44	2579.031	5.686949	511.8		
	3	1,054,000	42983857.3	0.07	3008870.01	3008.87	6.634774	597.1		
	4	554,400	22609345.8	0.06	1356560.75	1356.561	2.991314	269.2		
									1541.0	
1956	1	554,400	22609345.8	0.07	1582654.21	1582.654	3.489866	314.1		
	2	1,054,000	42983857.3	0.05	2149192.86	2149.193	4.739124	426.5		
	3	1,054,000	42983857.3	0.06	2579031.44	2579.031	5.686949	511.8		
	4	554,400	22609345.8	NR				0.0		dismantling;stripping complete
									1252.4	
1957	1	554,400	22609345.8	NR						
	2	1,054,000	42983857.3	NR						
	3	1,054,000	42983857.3	NR						
	4	554,400	22609345.8	NR						
									0.0	
1958	1	554,400	22609345.8	NR						
	2	1,054,000	42983857.3	0.09	3868547.15	3868.547	8.530424	767.7		B-4 extract ops
	3	1,054,000	42983857.3	0.06	2579031.44	2579.031	5.686949	511.8		
	4	554,400	22609345.8	0.04	904373.83	904.3738	1.994209	179.5		
									1459.0	
1959	1	554,400	22609345.8	0.03	678280.37	678.2804	1.495657	134.6		
	2	1,054,000	42983857.3	0.04	1719354.29	1719.354	3.791299	341.2		
	3	1,054,000	42983857.3	0.02	859677.15	859.6771	1.89565	170.6		
	4	554,400	22609345.8	0.06	1356560.75	1356.561	2.991314	269.2		
									915.7	
1960	1			NR						
	2									
	3									
	4									
									0.0	
							TOTALS	5839.6	5839.6	

Notes: Process area air Hg concs do NOT include Hg contaminated H2 gas measured in stack exhaust air. This is unique to Elex in 9204-4 bldg.

Beta 4

Tom-

I'm going to type this out and ask if you concur, or can think of a better resolution to a dilema I have. I need to give Samer an answer asap. THX!

Beta-4 Building

1. The Elex process produced mercury-contaminated hydrogen gas from the decomposition of the amalgam. The Hg Task Force cited a study of the building exhaust in Oct 1953 that estimated 8.46 lb Hg released per day. I have reviewed the handwritten calculations of this study and concur with the 8.46 lb. The process operated for 32 months (from August 1953 to March 1956) and assuming 7d/wk 24 h/d, this is 8300 lbs. (Hg Task Force). We initially spread this out over 3 yr @ 2767 lb per yr.

2. The Colex process water-scrubbed their hydrogen gas to remove the Hg (conc after scrub=0.02 mg/m3 >>> 10 lb of Hg released for all 8 yrs of Colex- this is nothing). Also note that I have read that Colex produced a lot less hydrogen gas from their process (decomposition reduced efficiency of the process and was undesirable). I have no data on the volume of gas or Hg content of the gas from the Elex process.

3. Ernie says that the building ventilation for the 6 summer months was doubled starting in 1955. I have a combination of weekly and monthly and quarterly average Hg building air concentrations for 1954-56. I don't think this Hg contaminated hydrogen was floating around the building floor areas (for safety reasons), but I know it was vented in the building exhaust and therefore would be included in the 8.46 lbs. To test that theory, I calculated the lbs using the air concs and Ernie's ventilation rates (for 1954-56) and it is much lower than the 8.46 lb/d. The mean + 1SD of the quarterly avgs for 1954-56 is 3.3 +/- 2.1 lbs/d.

4. I thought the other day that I would use both the exhaust and the building air, but that is double counting all Hg emissions other than the hydrogen vent gas.

If I apply the 8.46 lbs/d measured in Oct 1953 to the 1954-56 period, I'm ignoring the 50% increase in ventilation for 1955 and 1956.

I don't want to just use the indoor air concs because they wouldn't reflect the hydrogen gas.

			lbs in stack	lbs in indoor air	lbs in H2 gas
1953	45 dy	1142.1	380.7	NR (86)	381-86 avg45d= 295(45d)
1953	4thQ		761.4	122.1	761-122= 639
1954	1Q	3045.6	761.4	81.4	761-81= 680
1954	2Q		761.4	203.5	761-204= 557
1954	3Q		761.4	142.4	761-142= 619
1954	4Q		761.4	~~81.4~~ 122.1	761-~~81~~= 680
1955	1Q	3807.	761.4	.08 ~~NR~~ (~~173~~) 1628	761-173 avg90d= 588
1955	2Q S		1142.1	[511.8]	1142-512= [630]
1955	3Q S		1142.1	[597.1]	1142-597= [545]
1955	4Q		761.4	269.2	761-269= 492
1956	1Q	1699.7	761.4	314.1	761-314= 447
1956	2Q S		stripping bldg (426.5)	[426.5]	0
1956	3Q S		stripping bldg (511.8)	[511.8]	0
1957				NR -0-	0
1958			B4 extract(1459)	→ 1459	?
1959			B4 extract(916)	→ 916	?

Totals	12069	5895	6172

NOTES:
1. S= summer ventilation= 50% increase

2. The lbs Hg released per quarter based on indoor air for the pre-1955 and post-1955 winter ventilation conditions is 173+/- 92 (Mean +1SD). The post-1955 summer is 512+/- 70. (If I don't separate summer and winter after 1955 change, it's 300+/- 200, so that makes sense.)

3. The lbs Hg in the H2 gas is 588+/- 74. (looks fairly constant)

4. I plugged in avgs for ~~2~~ 1 missing Q~~s~~.
5. I assumed no hydrogen gas during stripping.
6. I adjusted the 1953 3rdQ to 45 d (started on 8-18-53).

There is another operation for which Hg air concs are available in Beta 4 building in 1957 and 1958 called Beta 4 extract. These are in Solvent Air Monthly reports from the top IH guy Leo LaFrance. I haven't found anyone alive who knows what this was. I included these even though the Hg Task Force report says nothing about this operation (total of 12069 = 17% of all Hg emissions from all bldgs for all yrs).

move

Confession: This reminds me of something about building air concentration data. For a lot (or all) of the data, avgs were reported for certain process areas of a building (purpose was to id problem areas). I sometimes have seen no. of samples data that show more samples were taken in some areas than in others. I did not (due to available time and $, or to lack of data) average individual daily values to get a true monthly avg. I used avgs of area avgs that were not equally weighted. Unavoidable. If more data were taken in problem areas this would bias the avg air conc high. Ernie said that there were spot ventilation add-ons in problem areas that were not shown on drawings, so I thought maybe this would bias the ventilation rates a little low and tip the scale back.

Calculation of Pounds of Mercury Exhausted to Atmosphere per Quarter from Building 9204-4

Year	Quarter	Exhaust		Hg Conc	Effluent					
		cfm	m3/day	mg/m3	mg/day	g/day	lbs/day	lbs/qtr	lbs/yr	Comments
1953	1									
	2						stack Hg			
Aug	3						8.46			
	4	554,400	22609346	0.06	1356560.75	1356.561	1.356561	122.1		
									122.1	vs. 761.4 USED
1954	1	554,400	22609346	0.04	904373.83	904.3738	0.904374	81.4		
	2	554,400	22609346	0.1	2260934.58	2260.935	2.260935	203.5		
	3	554,400	22609346	0.07	1582654.21	1582.654	1.582654	142.4		
	4	554,400	22609346	.06 0.04	904373.83	904.3738	0.904374	~~81.4~~ 122.1		
									508.7	vs. 3045.6 USED
1955 vent Hg.	1	554,400	22609346	.08 NR				~~761.4~~ 1628		
	2	1,054,000	42983857	0.06	2579031.44	2579.031	5.686949	511.8		
	3	1,054,000	42983857	0.07	3008870.01	3008.87	6.634774	597.1		
	4	554,400	22609346	0.06	1356560.75	1356.561	2.991314	269.2		
									2139.6	vs. 3045.6
1956 Mar	1	554,400	22609346	0.07	1582654.21	1582.654	3.489866	314.1		vs. 761.4
	2	1,054,000	42983857	0.05	2149192.86	2149.193	4.739124	426.5		vs. 761.4
	3	1,054,000	42983857	0.06	2579031.44	2579.031	5.686949	511.8		vs. 761.4
	4	554,400	22609346	NR				0.0		dismantling;stripping complete
									1252.4	vs. 2284.2
1957	1	554,400	22609346	NR						
	2	1,054,000	42983857	NR						
	3	1,054,000	42983857	NR						
	4	554,400	22609346	NR						
									0.0	
1958	1	554,400	22609346	NR						
	2	1,054,000	42983857	0.09	3868547.15	3868.547	8.530424	767.7		B-4 extract ops
	3	1,054,000	42983857	0.06	2579031.44	2579.031	5.686949	511.8		
	4	554,400	22609346	0.04	904373.83	904.3738	1.994209	179.5		
									1459.0	
1959	1	554,400	22609346	0.03	678280.37	678.2804	1.495657	134.6		
	2	1,054,000	42983857	0.04	1719354.29	1719.354	3.791299	341.2		
	3	1,054,000	42983857	0.02	859677.15	859.6771	1.89565	170.6		
	4	554,400	22609346	0.06	1356560.75	1356.561	2.991314	269.2		
									915.7	
1960	1			NR						
	2									
	3									
	4									
									0.0	
							TOTALS	5766.7	5766.7	vs. 9574 USED

* from Y/HG-0173 Oct 1953

Calculation of Pounds of Mercury Exhausted to Atmosphere per Quarter from Building 9204-4

Year	Quarter	Exhaust cfm	m3/day	Hg Conc mg/m3	Effluent mg/day	g/day	lbs/day	lbs/qtr	lbs/yr	Comments
1953	1									
	2									
	3 (Aug.)	~~554400~~					*			
	4	554,400	22609346	~~NR~~	.06		8.46	761.4	761.4	
1954	1	~~554400~~		~~NR~~	.04		8.46	761.4		
	2	~~554400~~		~~NR~~	.10		8.46	761.4		
	3	~~554400~~		~~NR~~	.07		8.46	761.4		
	4	~~554400~~		~~NR~~	.04		8.46	761.4	3045.6	
1955	1	~~1,054,000~~ 554,400	42983857	NR			8.46	761.4		
	2	1,054,000	42983857	0.06	2579031.44	2579.031	5.686949	511.8		
	3	1,054,000	42983857	0.07	3008870.01	3008.87	6.634774	597.1		
	4	~~1,054,000~~	42983857	0.06	2579031.44	2579.031	5.686949	~~511.8~~ 255.9		
									~~1620.8~~	~~1364.8~~ 2126.2
1956 (March)	1	~~1,054,000~~	42983857	0.07	3008870.01	3008.87	6.634774	~~597.1~~ 298.55		
	2	1,054,000	42983857	0.05	2149192.86	2149.193	4.739124	426.5		
	3	1,054,000	42983857	0.06	2579031.44	2579.031	5.686949	~~511.8~~ [illegible]		
	4	~~1,054,000~~	42983857	NR						dismantling;
									~~1535.5~~	stripping complete 980.95
1957	1	~~1,054,000~~	42983857	NR						
	2	1,054,000	42983857	NR						
	3	1,054,000	42983857	NR						
	4	~~1,054,000~~	42983857	NR						
									0.0	
1958	1	~~1,054,000~~	42983857	NR						?
	2	1,054,000	42983857	0.09	3868547.15	3868.547	8.530424	767.7		B-4 extract ops
	3	1,054,000	42983857	0.06	2579031.44	2579.031	5.686949	511.8		
	4	~~1,054,000~~	42983857	0.04	1719354.29	1719.354	3.791299	~~341.2~~ 170.6		1450.1
									~~1620.8~~	
1959	1	~~1,054,000~~	42983857	0.03	1289515.72	1289.516	2.843475	~~255.9~~ 127.95		
	2	1,054,000	42983857	0.04	1719354.29	1719.354	3.791299	341.2		
	3	1,054,000	42983857	0.02	859677.15	859.6771	1.89565	170.6		
	4	~~1,054,000~~	42983857	0.06	2579031.44	2579.031	5.686949	~~511.8~~ 255.9		
									~~1279.8~~	895.65
1960	1			NR						
	2									
	3									
	4									
									0.0	
							TOTALS	~~6056.6~~	~~6056.6~~	

b-4

Paul Wilkerson

July 27, 1996

Ventilation Systems of Building 9204-4
as Existed in 1953
by
E. E. Choat

Building Data

Figure 1 is a partial plan of the 2nd floor and a sectional view of building 9204-4 that is believed to be the building space occupied by the Elex Production Plant during the early 1950's. Elex occupied essentially all of the space between column lines 1 - 43, and F - J. It represents an area of 34,226 ft2 and a building volume of 1,745,550 ft^3.

Subsequent to the shutdown of the Elex Production Plant, the building was stripped of all process equipment so that new and different processes could be installed. Ventilation systems were then modified as necessary to accommodate the requirements of the new process. During these modifications, drawings of the building ventilation systems were changed according to the new design, and consequently, no longer reflected conditions that existed in 1952 - 55.

For this study, it has been necessary to search through existing drawings and documentation for sufficient information to reconstruct a model of the ventilation systems which existed in the early ~~fifties~~ 1950s.

Phase I Ventilation

The initial design for this plant was done by the Vitro Corporation, and provided for 554,400 cfm of exhaust. This volume of air in the space occupied by the Elex Plant resulted in an air change rate of 19 changes per hour.

Building exhaust is thought to have been by three modes as follows:

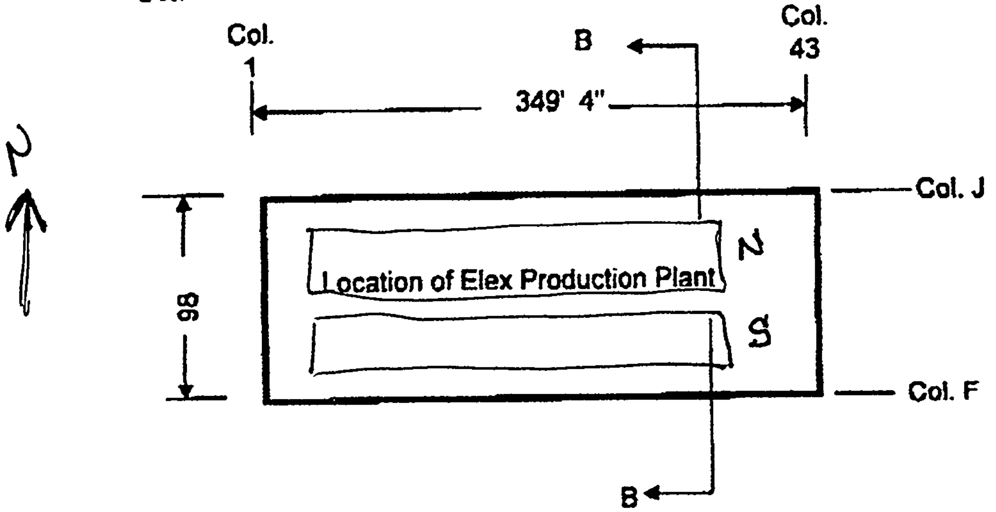
1. Nine (9) Roof Ventilators --- 194,400 cfm
2. Two (2) Exhaust Stacks --- 120,000 cfm
3. Six (6) Propeller Fans – mounted in the walls – 240,000 cfm

The location of these exhaust points is illustrated in Section B - B of Figure 1. They were also shown on Vitro drawing 50-K2-10. This drawing has been superseded by subsequent design changes and is now identified as Catalytic drawing B-32147. Master Plans of this building, completed in 1985, show these fans as still existing at that time.

Except for the two fans that exhausted to stacks, the sizes, air volume capacity, and outlet are summarized in Table 1. The two unidentified fans are believed to have been 2 centrifugal fans located on the 1st floor fan room on the North side of the building. These fans exhausted to stacks which extended up the outside wall to an elevation above the roof. as in 2 above? contributed to the 120,000 cfm?

gp

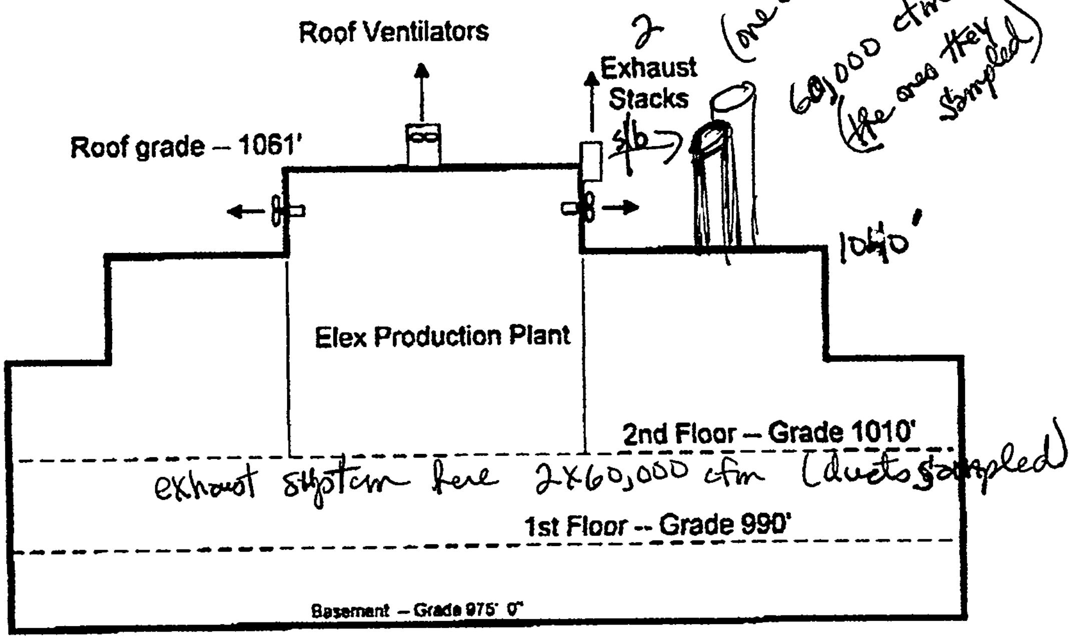
Figure 1
Plan and Sectional View of Elex Production Plant --- Building 9204-4



Partial Plan of 2nd Floor
Building 9204-4 -- grade 1010

Show:
North Plant ?
South Plant ?

chk: photograph in Hg TF Rpt. looking west
(S Wiley



Elevation B-B

Table 1
Exhaust Fans Provided for Elex Production Plant – Phase 1

		Air Volume Cfm	Fan size Inches	Outlet Area - ft²	Outlet Velocity Fpm			
10	Roof Ventilator	20000	36	7.07	2829			
11	Roof Ventilator	20000	36	7.07	2829	Reference:		
12	Roof Ventilator	24800	36	7.07	3508	Calalytic drawing B-32147.		
13	Roof Ventilator	20000	36	7.07	2829	Issue date 11/6/53. Includes		
14	Roof Ventilator	24800	36	7.07	3508	as built work under contract 40011.		
15	Roof Ventilator	20000	36	7.07	2829	Supersedes Vitro Dwg. 50-K2-10.		
16	Roof Ventilator	24800	36	7.07	3508			
17	Roof Ventilator	20000	36	7.07	2829			
18	Roof Ventilator	20000	36	7.07	2829			
	Exh. to Stack	60000	72 x 72	36.00	1667	Believed to be systems cited W.		
	Exh. to Stack	60000	72 x 72	36.00	1667	Brumann report to W. K. Whitson,		
K-10905-1	Prop Fan - wall	40000	60	19.64	2037	10/28/53.		
K-10905-2	Prop Fan - wall	40000	60	19.64	2037			
K-10905-3	Prop Fan - wall	40000	60	19.64	2037			
K-10905-4	Prop Fan - wall	40000	60	19.64	2037	See Vitro dwg. 86-K2-5		
K-10905-5	Prop Fan - wall	40000	60	19.64	2037	CFC 1953 - Jasny		
K-10905-6	Prop Fan - wall	40000	60	19.64	2037			
		554400						
				A total Exhaust of 554400 cfm correlates				
				well with 538,000 predicted from Brumann				
6/2/96				report.				
E. E. Choat								

where these 2 fans sit

The magnitude of exhaust ventilation provided in the initial design may also be extracted from W. Brumann's report to W. K. Whitson[1]. In this report, air sampling was done for 2 exhaust systems having a capacity of 60,000 cfm. At the concentrations reported for the North Plant, this volume of air would result in 0.86 pounds of mercury per day being delivered to the environment. But, the report stated that 3.8 pounds was lost. Therefore, 60,000 must have been only a part of the total air exhausted. The total air volume required to deliver 3.8 pounds to atmosphere at the concentrations given, is 264,167 cfm. This calculation along with air flows and concentrations from the Brumann report is shown in Table 2.

[1] W. Brumann, Industrial Hygiene Section, to W. K. Whitson, 10/28/53.

Table 2
Estimated Elex Exhaust from Brumann Report [1]

	Exhaust		Concentration					
Sample	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day		
1	7500	305856	0.14	42819.84	42.81984	0.09		
2	7500	305856	0.14	42819.84	42.81984	0.09		
3	7500	305856	0.12	36702.72	36.70272	0.08		
4	7500	305856	0.15	45878.4	45.8784	0.10		
5	7500	305856	0.22	67288.32	67.28832	0.15		
6	7500	305856	0.2	61171.2	61.1712	0.13		
7	7500	305856	0.15	45878.4	45.8784	0.10		
8	7500	305856	0.16	48936.96	48.93696	0.11		
	60000	2446848		391495.7	391.4957	0.86		
Average Concentration Reported = .16								
Total Reported Solvent Loss from the North Plant = 3.8 lbs.						For this total loss, air flow		
must be 3.8/.86309 higher. Then, Cfm = 60000*3.8/0.86309							Cfm =	264167
North → Plant Total	265000	10806912	0.16	1729106	1729.106	3.81	agrees with report	
9	7500	305856	0.22	67288.32	67.28832	0.15		
10	7500	305856	0.22	67288.32	67.28832	0.15		
11	7500	305856	0.21	64229.76	64.22976	0.14		
12	7500	305856	0.21	64229.76	64.22976	0.14		
13	7500	305856	0.19	58112.64	58.11264	0.13		
14	7500	305856	0.17	51995.52	51.99552	0.11		
15	7500	305856	0.16	48936.96	48.93696	0.11		
16	7500	305856	0.18	55054.08	55.05408	0.12		
	60000					1.05		
Average Concentration Reported = .0.20								
Total Reported Solvent Loss from the South Plant = 4.8 lbs.						For this total loss, air flow		
must be 4.8/1.05 higher. Then, Cfm = 60000*4.8/1.05.							Cfm =	274286
South → Plant Total	265000	10806912	0.2	2161382	2161	4.76	agrees with report	
Total Building Exhaust is estimated to be = 274,286 + 264167						=	538453	
5/8/96 — Today I talked with Bill Whitson. He is 82 now and not well. He thinks that the wall fans proposed in 1954 were installed.								
6/14/96 -- Talked to Glenn Kitchings -- draftsman on B-4 master plans. He is now working at Downtown Hardware.								

In the same manner, total air flow from the South Plant was calculated as being 274,286 cfm. The sum of North plant exhaust and South plant exhaust

1

is equal to 538,453 cfm which is only 3% less than values shown on the drawings.

Phase II Ventilation

Additional ventilation of the Elex Plant is believed to have been installed in the later months of 1954. In a letter -- to Mr. R. C. Armstrong, USAEC from J. P. Murray, Y-12 Plant Superintendent – of 7/15/54, it was noted that contamination levels were too high. This letter also recommended 500,000 cfm of additional ventilation. This was to be accomplished with additional propeller fans installed in walls around the cascade.

I believe that this proposal was implemented for the following reasons:

1. I have talked to two people who were employees in the 9204-4 building during the time of Elex, and they both think that this plan was implemented.

2. Also, Martin Maritta drawings H2E002078MP & H2E002079MP – show 16 fans installed in the walls along columns F & J. These drawings are from the "Master Plan" series, dated 5/8/85. Six of these fans are the same as those shown in the original design by Vitro. The other 10 are believed to be those referenced in the Armstrong letter. These ten fans of a moderate size could have easily provided the 500000 cfm cited. I believe this air volume to be near that installed, as it was noted that the fans were "on hand" in Y-12.

With an additional exhaust of 500000 cfm, the air change rate during the summer operation of the Elex Production Plant would have been 36 changes per hour.

any winter?

538453
500000
1,038,453 cfm

36 air changes/hr

July 28, 1996

Ventilation Systems of Building 9201-2
as Existed in 1955
by
E. E. Choat

Building Data

Building 9201-2 was built in the early 40's to house a portion of the electromagnetic uranium separation process. It was shut down about 1947 but was not stripped of it's contents. At the time of the Colex Pilot Plant - which occupied only a small portion of the building - a major portion of the previous process was still in place.

*SMF Need more history/dates added here.

Figure 1 is a key plan of Building 9201-2 and a sectional elevation of that building. It is provided here to show the location of the Colex Pilot Plant that existed there in the (early 50's.) As shown here, two (2) Absorber Trays were located along column line "d" between column lines "15" & "20". Floor area occupied by this equipment was approximately 20 x 90 feet or 1800 ft^2. These two trays are shown on drawing E-HV-20238. A third tray was reported in an Industrial Hygiene Report of 12/19/54. I assume it was in the same vicinity and occupied about 1200 ft^2.

Other components of the ~~P~~lant - consisting of columns, pumps, etc. - were installed along the east end of the building, between column lines "d" & "k". It occupied a floor area of approximately 4000 ft^2 on three floors.

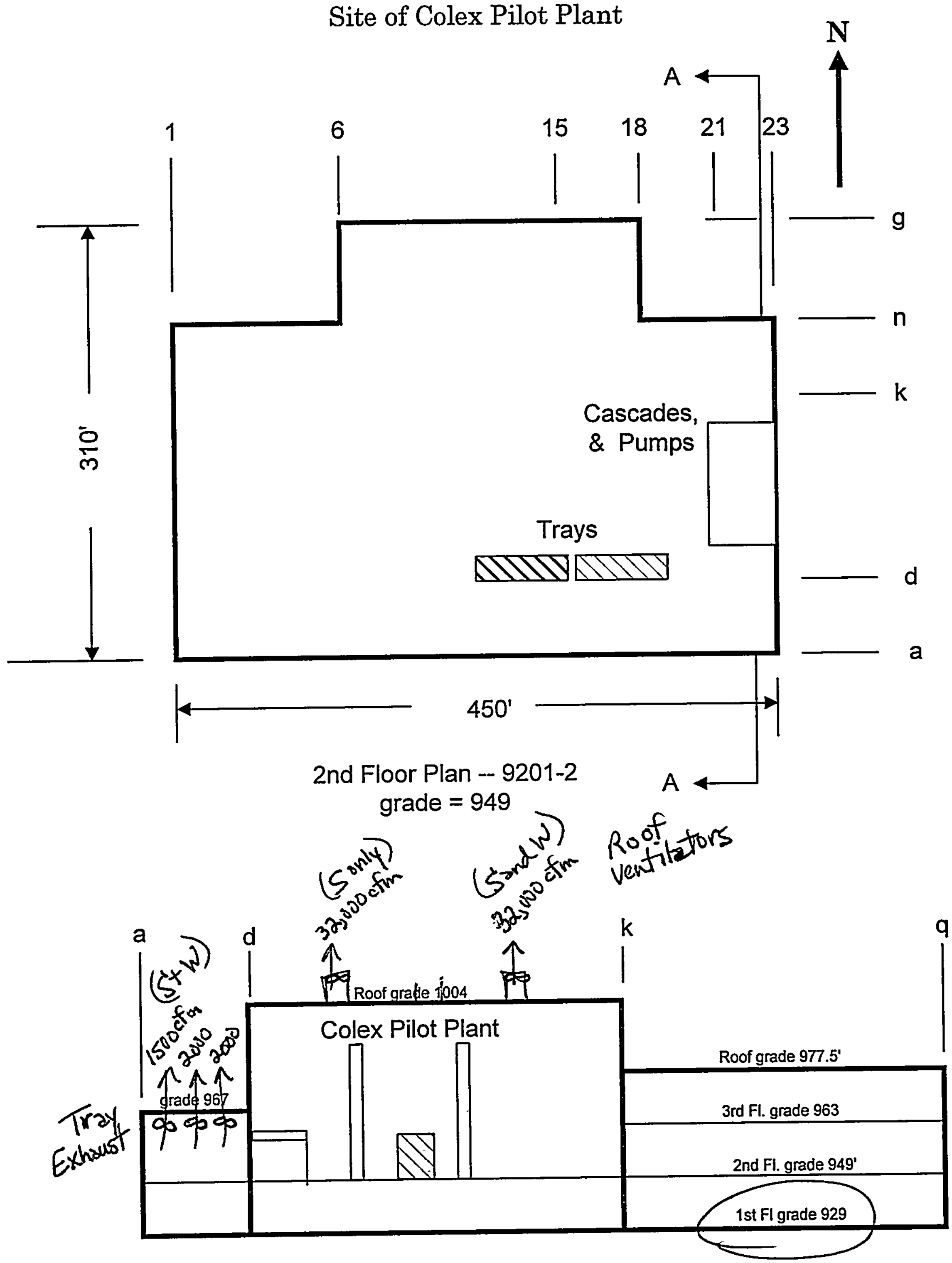
The total building volume that was occupied by the Colex Pilot Plant is estimated to be 525,000 ft^3.

Supporting services, - such as Maintenance, Development Offices, Engineering Offices, & DC power supply were located in adjacent areas. A major portion of the building was unoccupied but did house ~~the~~ a remnants of the former uranium separator process.

Subsequent to ~~the~~ shutdown of the Colex Pilot Plant, the building was stripped of the Colex process equipment so that new and different processes could be installed. Ventilation systems were then modified as necessary to accommodate the requirements of the new process. During these modifications, drawings of the building ventilation systems were changed according to the new design, and consequently, no longer reflect conditions that existed in 1952 - 55.

For this study, it has been necessary to search through existing drawings and documentation for sufficient information to reconstruct a model of the ventilation systems which existed in early fifties. Also factored into this study is the ~~personal~~ professional opinion of one of the design engineers (E. E. Choat) who was a part of the engineering team for the Colex Pilot Plant project.

Figure 1
Site of Colex Pilot Plant



Elevation A - A
See

Process Ventilation

Process ventilation for this plant consisted of an exhaust system from each of the Absorber Trays. The details of one of these are shown on E-HV-20238, "Absorber Tray Ventilation", 1955. An air volume of 1500 cfm was exhausted by this system to 6 feet above the roof south of column line "d". The elevation of this roof is 967 feet above sea level. 1955
973'

A portion of the exhaust system for the second tray is also shown on E-HV-20238. However, it does not show the volume of air exhausted nor the point of exit. Since it does have slightly larger ducts, the exhaust volume is estimated to be 2000 cfm. It too, was probably exhausted above the roof at an elevation of 967. 1958

The third tray is assumed to have been a slight variation of the trays 1 & 2, and to have a comparable exhaust system - i.e. 2000 cfm exhausted to the low roof south of column line "d". 12/54

General Ventilation

General ventilation for the Colex Pilot Plant was almost non-existent. It consisted of systems that were installed for the previous process and that were still operable. These systems were not equipped with heating coils as the previous process was a terrific heat generator --- no heating was required. also Too, supply was introduced toward the center of the building as needed by the previous process. It was not very effective in ventilating the area occupied by the Colex Pilot Plant. Supply air could have been as much as 64000 cfm in summer. It was probably half of this in winter.

General exhaust for the building was via roof ventilators located on the high roof (elevation 1004). An unknown number of these fans were operable and running during the Colex Pilot Plant operation. It is estimated that 2 fans were operated in summer and that only one was used in winter. Then, building general exhaust would be 32000 cfm in winter and 64000 cfm in summer. 1970

Based upon the foregoing assumptions, air change rates for this plant is estimated to be 8 changes per hour for summer and 4 changes per hour for winter operation.

Also based upon the ~~foregoing~~ above assumptions, Mercury introduced into the atmosphere from the Colex Pilot Plant is estimated to be ~~1.19~~ 1.21 pounds per day during the summer and ~~0.63~~ 0.65 pounds per day during the winter. Calculations for these values are shown in Tables 1 and 2 that follow.

Table 1
Calculated Mercury Loss to Atmosphere for Summer Operation

elev

(1,2) 12-19-54

	Exhaust	40.781	x Concentration (3)		453.5	
5500	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day
Tray Exhaust	~~4500~~	224296 ~~183514~~	0.18	40373.19 ~~33032.45~~	40.37319 ~~33.03245~~	~~0.07~~ .09
General Ventilation	64000	2609971	0.194	506334.4	506.3344	1.12
Total	68500	2793485		539366.9	539.3669	~~1.19~~ 1.21

2000
2000
+ 1500
5500

973'
1004'

x 90d = 108 lb/quarter for 2 qtrs.

525000 ft³

Table 2
Calculated Mercury Loss to Atmosphere for Winter Operation

(1,2) 12-19-54

	Exhaust		Concentration (3)			
5500	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day
Tray Exhaust	~~4500~~	224296 ~~183514~~	0.18	40373.19 ~~33032.45~~	40.37319 ~~33.03245~~	~~0.07~~ .09
General Ventilation	32000	1304986	0.194	253167.2	253.1672	0.56
Total	36500	1488499		286199.7	286.1997	~~0.63~~ .65

x 90d = 58.5 lb/qtr. for 2 qtrs.

References:

1. "Absorber Tray Ventilation", a Union Carbide drawing number E-HV-20238, 1955.
2. Key Plans H&V Flow, a Union Carbide drawing number E-M-318 and others in this series. A list is given on this document, 1970.
3. Weekly Solvent Work Sheets, 1954.

IH Report 12-19-54

Q: The exhaust Hg conc's are higher than the bldg. avg. concs

IH Alloy Div. monthly reports 1955-60. ~~GnF... EFC~~

* have air concs 1955-1957 in A-2

grnd-level elev

Temp		CFm	FAN diam	FAN area	fpm Velocity	Direction	Elev.	
293.15	Roof exhaust tray 1	1500	--	--	2200	up	973'	-929 =
	" " tray 2	2000	--	--	2200		973'	
	" " tray 3	2000	--	--	2200		973'	Summer Only
	Roof ventilator gen. ventilation → Fan 1	32000	--	--	2200		1004'	
	Roof ventilator → Fan 2	32000	--	--	2200		1004'	Summer + Winter

48,000 cfm ann. avg.

See Figure 1

$\frac{2000 \text{ cfm}}{2200 \text{ fpm}} = .9 \text{ ft}^2$

$\frac{\pi d^2}{4} = .9$

$d^2 = \frac{3.6}{3.14}$

$d = 1.07 \text{ ft}$

Calculation of Pounds of Mercury Exhausted to Atmosphere per Quarter from Building 9201-2

Year	Quarter	Exhaust cfm	m3/day	Hg Conc mg/m3	Effluent mg/day	g/day	lbs/day	lbs/qtr	lbs/yr	Comments
1953	1	36500		0.07				20.7		
	2	68500		0.09				49.9		
	3	68500		0.09				49.9		
	4	36500		0.14				41.4		
									161.8	
1954	1	36500		0.14				41.4		
	2	68500		0.07				38.8		
	3	68500		0.11				61.0		
	4	36,500	1488530	0.20 ~~NR~~				59.1		
									200.2	
1955	1	36,500	1488530	NR				0		
	2	68,500	2793543	0.09	251418.86	251.4189	0.554397	49.9		
	3	68,500	2793543	0.07	195548.00	195.548	0.431197	38.8		
	4	36,500	1488530	0.09	133967.71	133.9677	0.295408	26.6		
									115.3	
1956	1	36,500	1488530	0.08	119082.41	119.0824	0.262585	23.6		
	2	68,500	2793543	0.06	167612.57	167.6126	0.369598	33.3		
	3	68,500	2793543	0.03	83806.29	83.80629	0.184799	16.6		
	4	36,500	1488530	0.02	29770.60	29.7706	0.065646	5.9		
									79.4	
1957	1	36,500	1488530	0.03	44655.90	44.6559	0.098469	8.9		
	2	68,500	2793543	0.04	111741.72	111.7417	0.246398	22.2		
	3	68,500	2793543	0.02	55870.86	55.87086	0.123199	11.1		
	4	36,500	1488530	0.08	119082.41	119.0824	0.262585	23.6		basement exhaust off
									65.8	-23.6 = 42.2
1958	1	36,500	1488530	0.05	74426.51	74.42651	0.164116	14.8		
	2	68,500	2793543	0.11	307289.72	307.2897	0.677596	61.0		
	3	68,500	2793543	0.16	446966.86	446.9669	0.985594	88.7		
	4	36,500	1488530	NR						
									164.5	
1959	1	36,500	1488530	NR						
	2	68,500	2793543	NR						
	3	68,500	2793543	0.06	167612.57	167.6126	0.369598	33.3		
	4	36,500	1488530	0.05	74426.51	74.42651	0.164116	14.8		
									48.0	
1960	1			NR						
	2									
	3									
	4									
									0.0	
							TOTALS	~~473.0~~ 835	~~473.0~~ ~~835~~ ~~236.9~~ 599	

115.3
79.4
42.2
236.9
161.8
200.2
598.9

1/12/97 b4a2airp.xls smf

August 1, 1996

Ventilation Systems of Building 81 - 10
as Existed in 1955
by
E. E. Choat

Building Data

Building 81 - 10, Solvent (Mercury) Salvage Facility, consisted of: a Gas Fired Furnace, Drum Unloading Devices, Conveyor, Crusher, & Cutter. These were mounted on a platform which ~~may have been~~ was covered with a roof. An equipment plan of this facility is shown on drawings F4A-18002, F4A-18003 and F4A-18004.

The Furnace was approximately 5 feet in diameter and 16 feet tall. It was mounted vertically beneath a platform and was heated via gas fired burners. Various materials - such as waste insulation and dust collected from spills - which were contaminated with Mercury were introduced into the top, heated to a high temperature to vaporize the mercury and thus separate it from the solid materials. Solids and/or ash were then removed from the bottom. (Temp)

The furnace was equipped with a cooling coil to cool hot flue gases to condense and separate the mercury from the gas, as a liquid.

The manufacturer's drawings of this furnace, along with information on the burners exist in the Y-12 plant files. These materials are "copyrighted" and are therefore available on a read-only basis.

I have not found any information regarding any ventilation that was provided for this facility. It seems possible that the only ventilation that existed was that provided by the wind blowing through the shed.

a 1957 letter refers to various measurements of the ~~loss~~ of mercury from the ~~exhaust point~~ sludge burner. An stacked handwritten calculation refers to a 14 inch stack diameter and a 1300 cfm volume flow rate.

Y/TS-1471

References

81-10 Demolition, Y-12 Plant Archeological & Historical Review (AHR) for Bldg.

* need date + author 1. manufacturer's drawings of furnace

✓ 2. 81-10 demolition report w photos

✓ 4. logsheets with handwritten diameter and volume flow rate Y/HG-0169
Sludge Burner stack loss of solvent.
Morehead to Whitson letter 6/18/57

3. Stripping Plan for 81-10 by F.V. Tilson 9-22-83 draft, Y/TS-1610.

August 6, 1996

Y-12 Steam Plants
Buildings 9401-1, 9401-2, & 9401-3
by
E. E. Choat

ask EEC
2200 cfm ?

Building Data

Building 9401-1 & 9401-2 were relatively small, coal fired boiler plants, constructed in the 1940's to provide steam for processes and for heating buildings ~~in~~ Y-12. As recalled, they consisted of two boilers each which were equipped with traveling grate stokers. They were superseded by the construction of Building 9401-3 in the mid 50's and were shut down. Subsequently, both buildings were converted to other uses.

2 stacks

Each of these buildings had a smoke stack, which has been removed subsequent to shut-down of the plants. Drawings have ~~not~~ been located that show sizes ~~and~~ but not heights of these stacks. From my personal recollection of these, I would estimate that the height of these was about 100 feet. Photographs of 9401-1 and 9201-2 have been located, but they do not show the entire stack.

Building 9401-3 consists of 4 boilers having a full-load capacity of 250,000 pounds of steam per hour each – or a total of 1,000,000 pounds per hour. Initially, it was a pulverized coal fired plant, but was converted to use natural gas shortly after start up in 1956. The operating choice of fuel was made on the relative prices and the availability of gas. As I recall, the plant burned gas during summer months and coal in winter. Most likely, this practice varied from year to year.

This plant has two stacks that transport products of combustion to a an emission point that is 190 feet above grade. The west stack is 12.5 feet in diameter. The east stack is 15 feet in diameter. The top elevation of both is 1161 feet above sea level.

Effluents

Mercury emissions from these plants would vary widely depending upon fuel being used, the quantity of fuel, and mercury content of the fuel. I believe that plant operating records probably exist which would contain dated fuel usage and steam output. However, I do not recall having ever seen either a coal nor natural gas analysis ~~that~~ ~~tested~~ for mercury.

References
✓ 1. photos of stm plants, 1-17-57
✓ 2. steam plants report Historical Bldg. Assessment of the Oak Ridge Y-12 Plant by Thomason & Assoc., May 1996, A-256, A-405, A-494.

July 28, 1996

Ventilation Systems of Building 9201-2
as Existed in 1955
by
E. E. Choat

Building Data Uranium Separation

Building 9201-2 was built in the early 40's to house a portion of the electromagnetic process. It was shut down about 1947 but was not stripped of it's contents. At the time of the Colex Pilot Plant - which occupied only a small portion of the building - a major portion of the previous process was still in place.

Figure 1 is a key plan of building 9201-2 and a sectional elevation of that building. It is provided here to show the location of the Colex Pilot Plant that existed there in the early 50's. As shown here, two (2) Absorber Trays were located along column line "d" between column lines "15" & "20". Floor area occupied by this equipment was approximately 20 x 90 feet or 1800 ft^2. These two trays are shown on drawing E-HV-20238. A third tray was reported in an Industrial Hygiene Report of 12/19/54. I assume it was in the same vicinity and occupied about 1200 ft^2.

Other components of the Plant - consisting of columns, pumps, etc. - were installed along the east end of the building, between column lines "d" & "k". It occupied a floor area of approximately 4000 ft^2 on three floors.

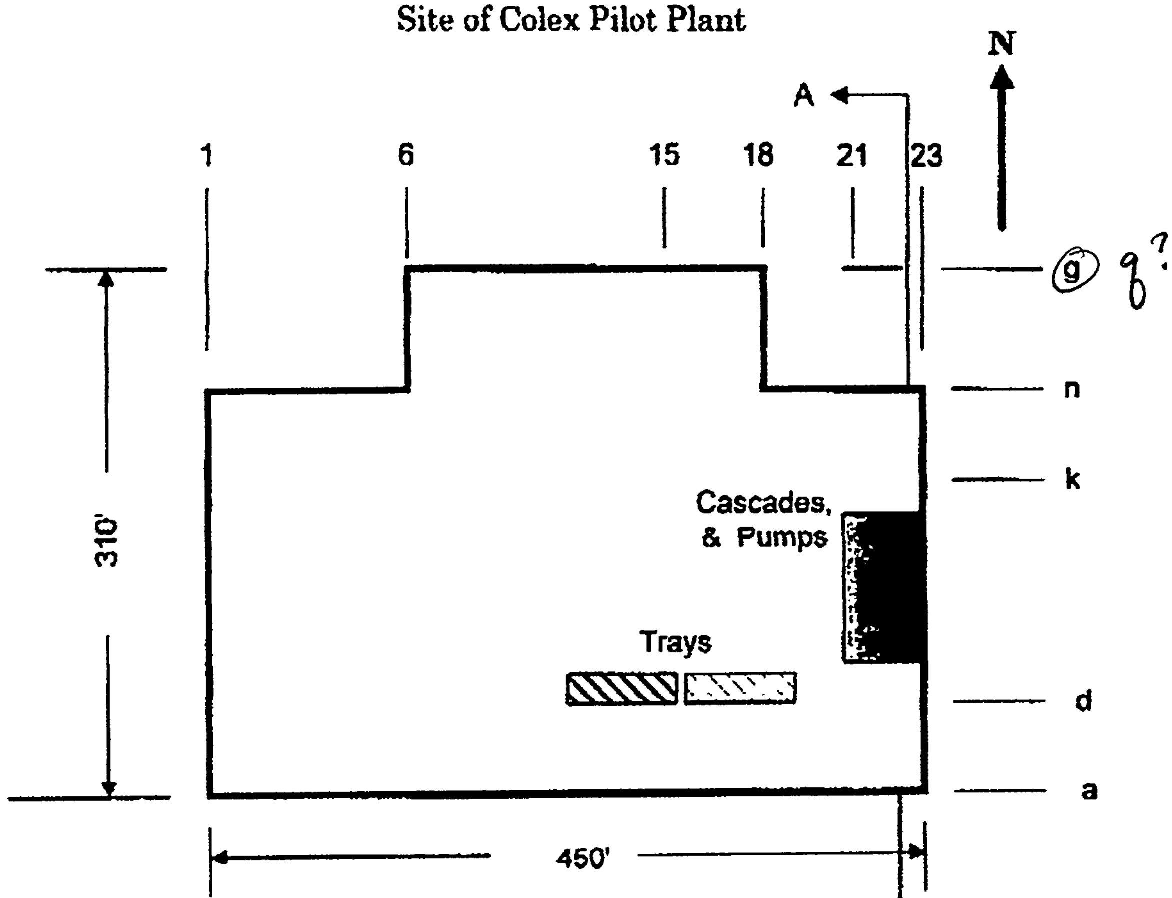
The total building volume that was occupied by the Colex Pilot Plant is estimated to be 525,000 ft^3.

Supporting services, - such as Maintenance, Development Offices, Engineering Offices, & DC power supply were located in adjacent areas. A major portion of the building was unoccupied but did house the remnants of the former process.

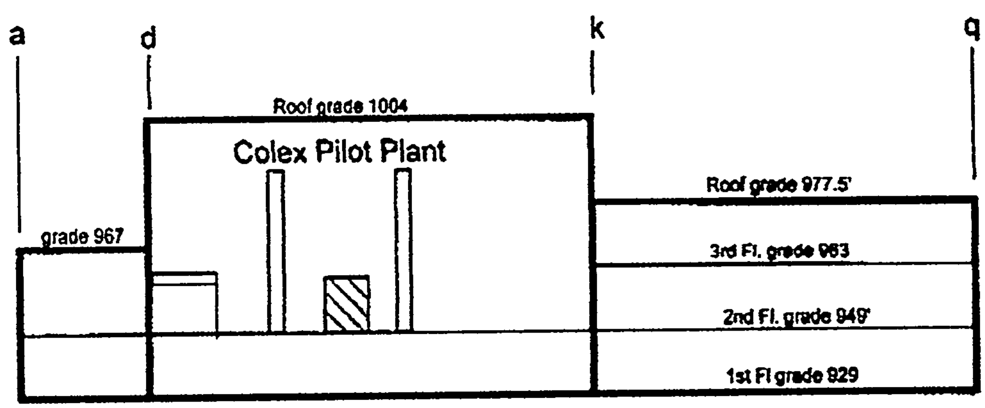
Subsequent to the shutdown of the Colex Pilot Plant, the building was stripped of the Colex process equipment so that new and different processes could be installed. Ventilation systems were then modified as necessary to accommodate the requirements of the new process. During these modifications, drawings of the building ventilation systems were changed according to the new design, and consequently, no longer reflect conditions that existed in 1952 - 55.

For this study, it has been necessary to search through existing drawings and documentation for sufficient information to reconstruct a model of the ventilation systems which existed in early fifties. Also factored into this study is the ~~personal~~ professional opinion of one of the design engineers (E. E. Choat) who was a part of the engineering team for the Colex Pilot Plant project.

Figure 1
Site of Colex Pilot Plant



2nd Floor Plan -- 9201-2
grade = 949



Elevation A - A

Process Ventilation

Process ventilation for this plant consisted of an exhaust system from each of the Absorber Trays. The details of one of these are shown on E-HV-20238, "Absorber Tray Ventilation", 1955. An air volume of 1500 cfm was exhausted by this system to 6 feet above the roof south of column line "d". The elevation of this roof is 967 feet above sea level.

technically, we should use 967+6

A portion of the exhaust system for the second tray is also shown on E-HV-20238. However, it does not show the volume of air exhausted nor the point of exit. Since it does have slightly larger ducts, the exhaust volume is estimated to be 2000 cfm. It too, was probably exhausted above the roof at an elevation of 967.

But, to be consistent just use roof grade

The third tray is assumed to have been a slight variation of the trays 1 & 2, and to have a comparable exhaust system - i.e. 2000 cfm exhausted to the low roof south of column line "d".

General Ventilation

General ventilation for the Colex Pilot Plant was almost non-existent. It consisted of systems that were installed for the previous process and that were still operable. These systems were not equipped with heating coils as the previous process was a terrific heat generator --- no heating was required. Too, supply air was introduced toward the center of the building as needed by the previous process. It was not very effective in ventilating the area occupied by the Colex Pilot Plant. Supply air could have been as much as 64000 cfm in summer. It was probably half of this in winter.

this fan has a "bonnet"

• use ∅ for vertical velocity

General exhaust for the building was via roof ventilators located on the high roof (elevation 1004). An unknown number of these fans were operable and running during the Colex Pilot Plant operation. It is estimated that 2 fans were operated in summer and that only one was used in winter. Then, building general exhaust would be 32000 cfm in winter and 64000 cfm in summer.

For ones straight-up 2000 ft/min

Based upon the foregoing assumptions, air change rates for this plant is estimated to be 8 changes per hour for summer and 4 changes per hour for winter operation.

~2000-2500 guessed for "thing" in A-4, A-5

Also based upon the foregoing assumptions, Mercury introduced into the atmosphere from the Colex Pilot Plant is estimated to be 1.19 pounds per day during the summer and 0.63 pounds per day during the winter. Calculations for these values are shown in Table 1 and 2 that follow.

Table 1
Calculated Mercury Loss to Atmosphere for Summer Operation

	Exhaust		Concentration			
	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day
Tray Exhaust	4500	183514	0.18	33032.45	33.03245	0.07
General Ventilation	64000	2609971	0.194	506334.4	506.3344	1.12
Total	68500	2793485		539366.9	539.3669	1.19

Table 2
Calculated Mercury Loss to Atmosphere for Winter Operation

	Exhaust		Concentration			
	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day
Tray Exhaust	4500	183514	0.18	33032.45	33.03245	0.07
General Ventilation	32000	1304986	0.194	253167.2	253.1672	0.56
Total	36500	1488499		286199.7	286.1997	0.63

References:

1. "Absorber Tray Ventilation", a Union Carbide drawing number E-HV-20238, 1955.
2. Key Plans H&V Flow, a Union Carbide drawing number E-M-318 and others in this series. A list is given on this document., 1970.
3. Weekly Solvent Work Sheets, 1954.
IH Report 12-19-54

Figure 1
3rd Floor Plan -- Building 9201-5

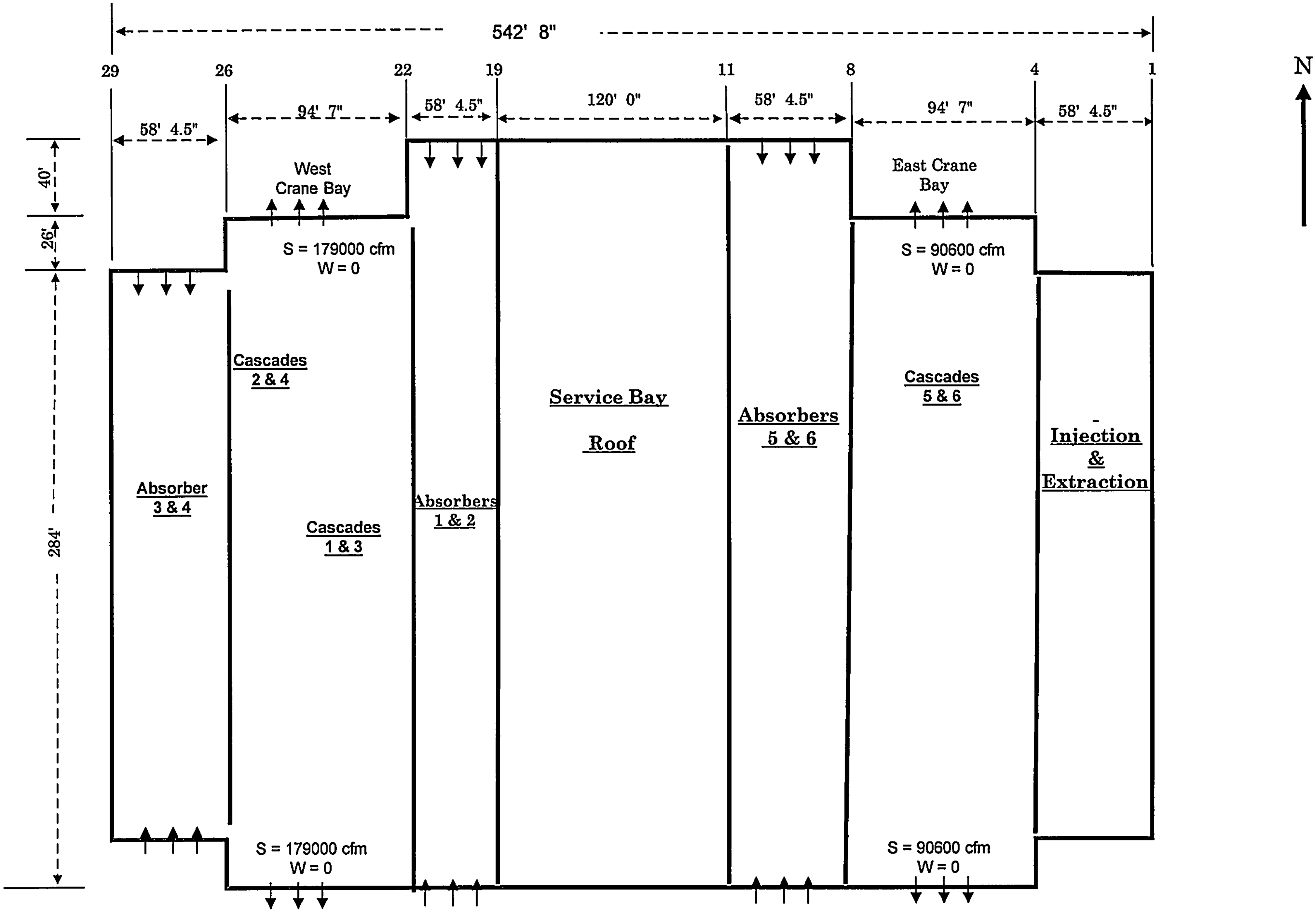


Figure 2
Section A - A ---- Building 9201-5

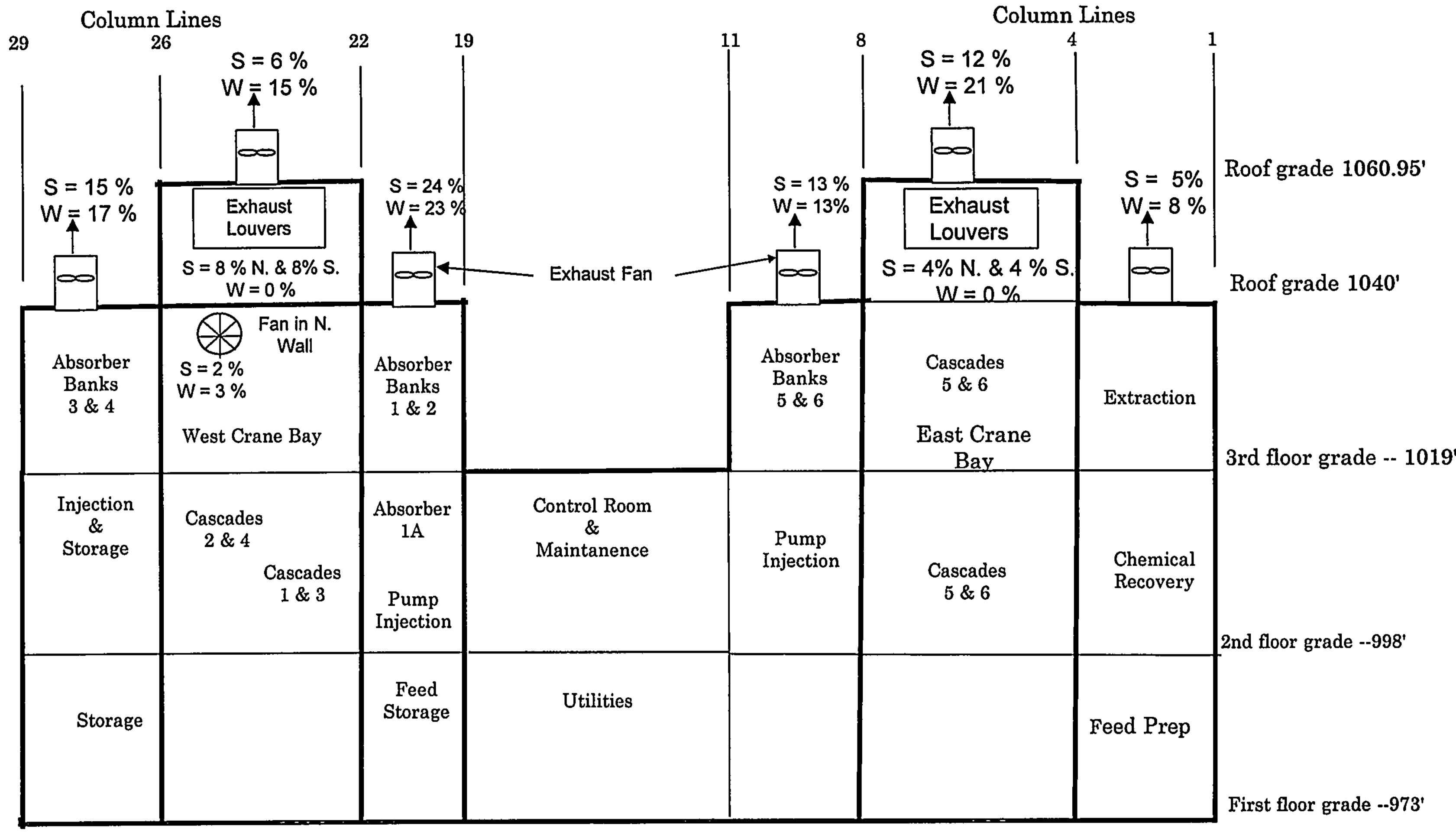


Figure 1
"1st Floor Plan" -- Building 9201-4

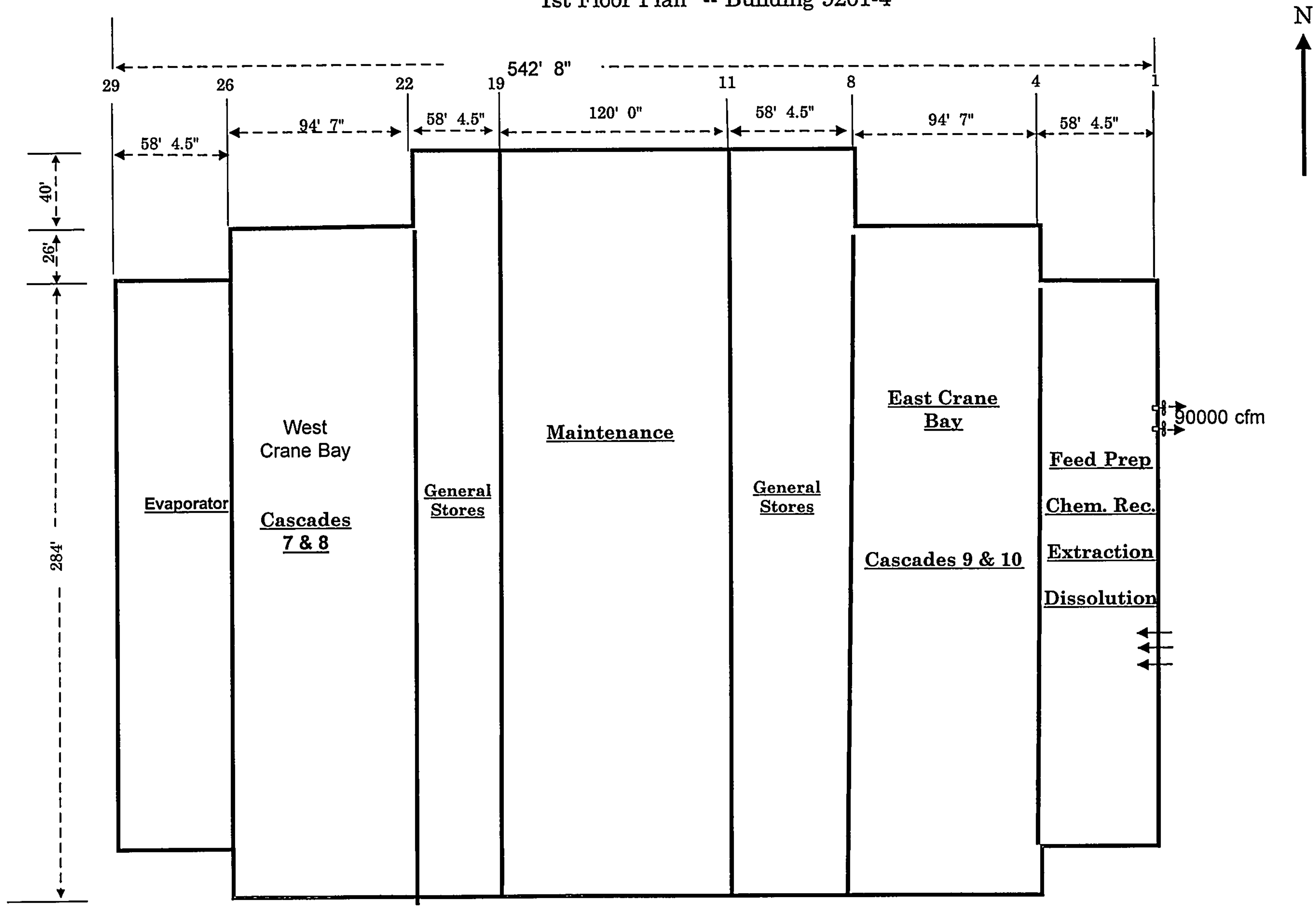


Figure 2
"2nd Floor Plan" -- Building 9201-4

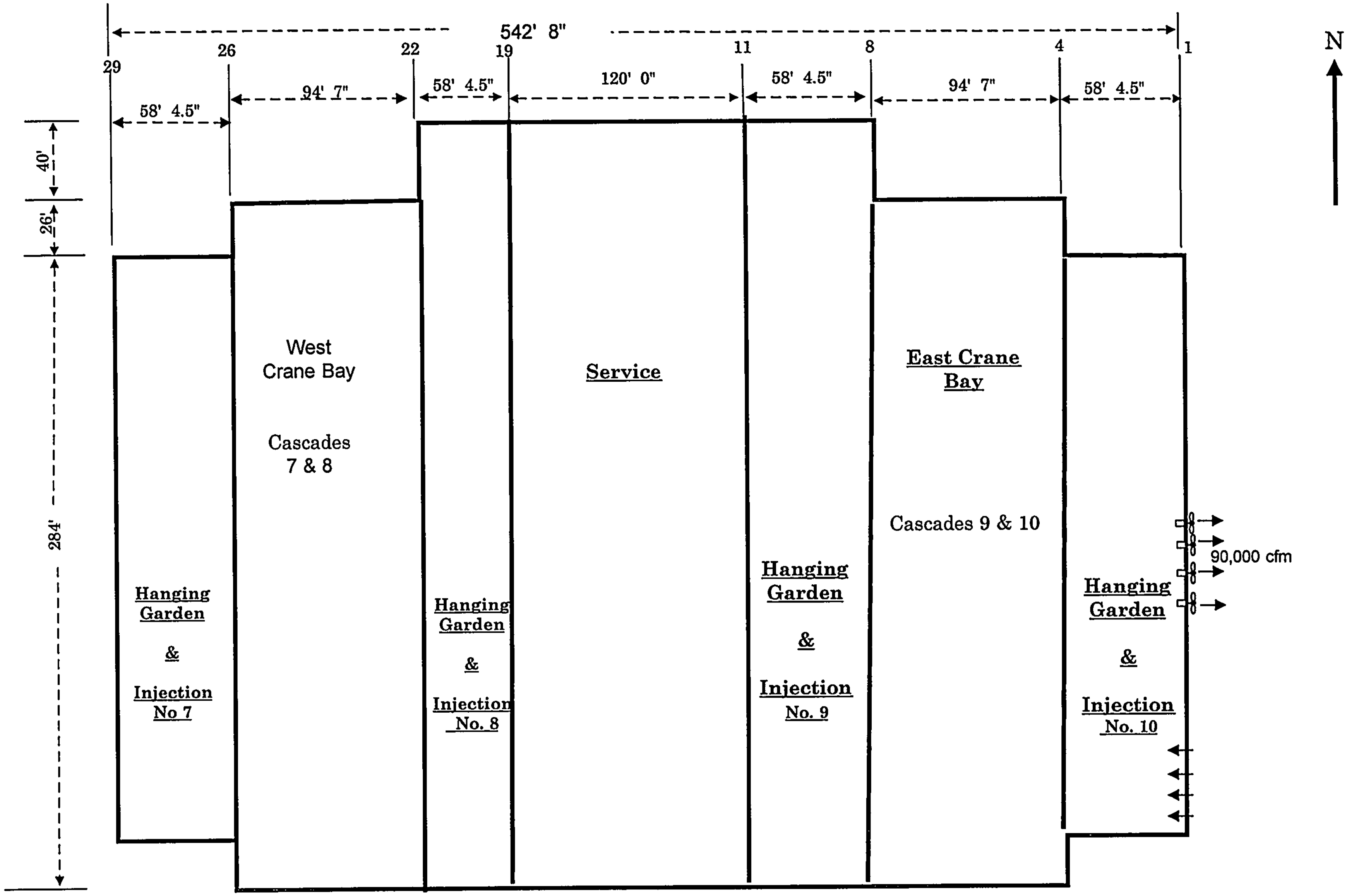


Figure 3
"3rd Floor Plan" -- Building 9201-4

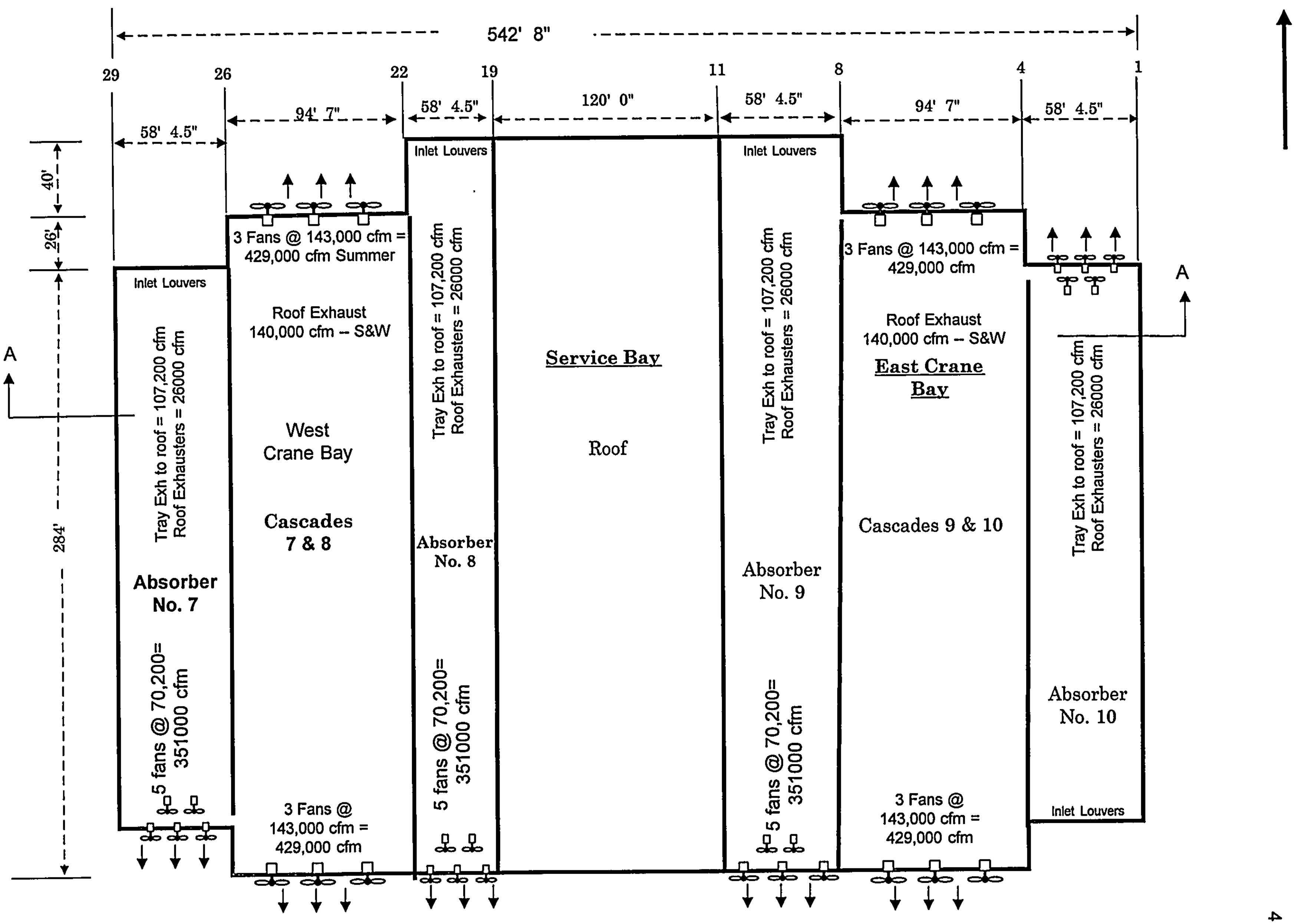
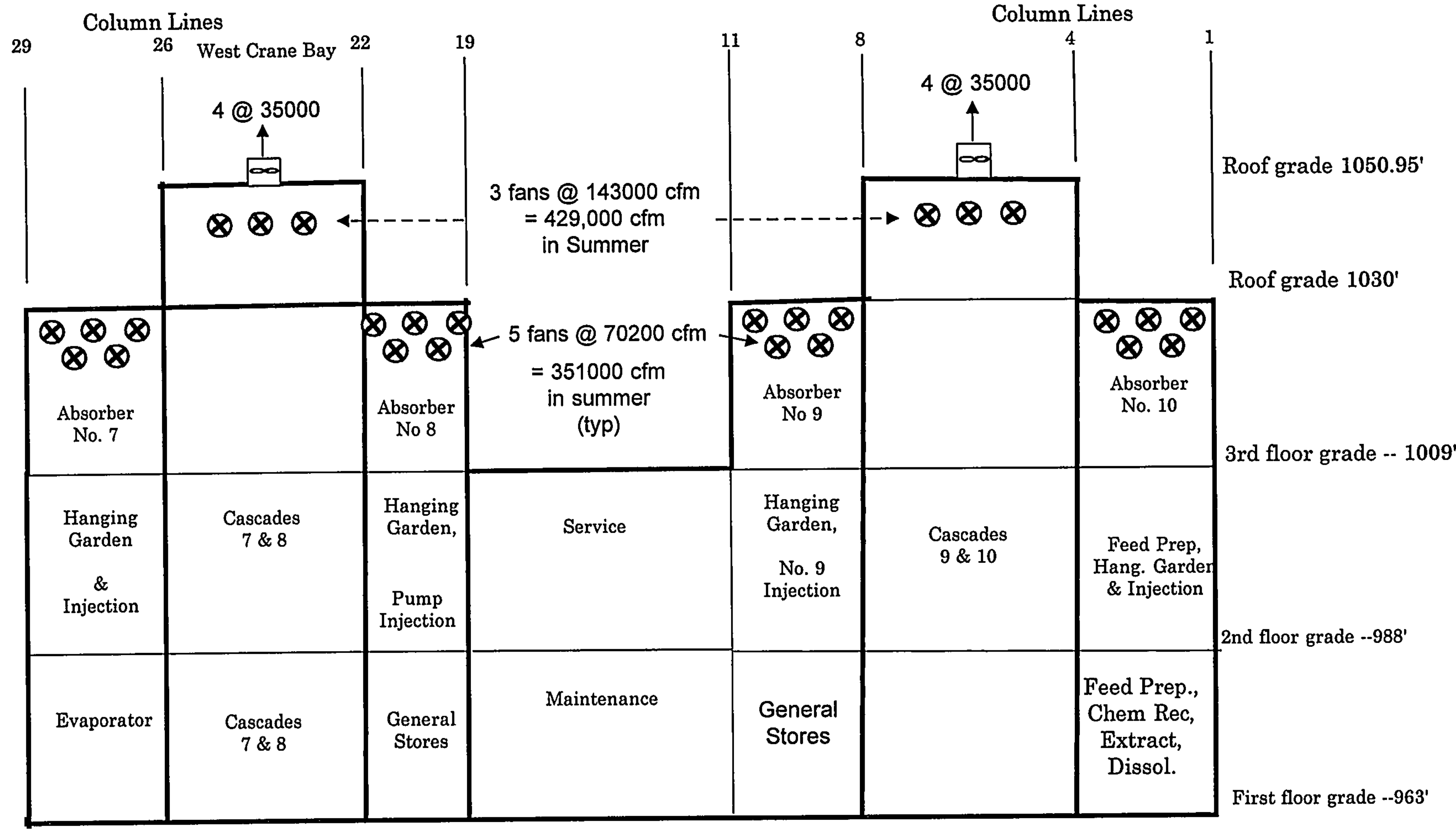


Figure 4
Section A - A (Looking North)---- Building 9201-4



FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: **E. E. Choat** (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: ~~7/23/96~~
8-9-96

Pages including this cover page -- 11

Responses to your questions of 8/8/96 FAX.

✓ 1. A good average value for release velocities would be 2200 fpm.

2. I can understand why you did not understand 2%. I didn't do a very good job of writing that.

I have made a second attempt to describe exhaust points in the form of two additional tables in the report. For these tables --- table 3 & 4 – shown the location of all exhaust fans, air volumes associated with these and percentages. You will note that these are somewhat different than other tables having design values. It's because some of these fans sit on a roof that is adjacent to the space that is being exhausted.

Also, I have written percentages on figure 2 that may be compared directly with tables 3 & 4. I believe that this format will read a lot easier for you.

These changes make it necessary to revise the report. Accordingly, I am sending via FAX along with this cover sheet.

3. For buildings 9201-4, 9201-5, and 9204-4 – Air flows given in this report should be with plus or minus 3 %. For 9201-2, values given are a reasonable guess. wag?

10%

✓ 4. My best wild guess (wag) for the gas temperature leaving the furnace would be 200 degrees F.

E. E. Choat

C O V E R

S H E E T

FAX

To: Ernie Choat
Fax #: 423- 482-2605
Subject: Questions on Ventilation Parame
Date: August 8, 1996
Pages: 1, including this cover sheet.

Post-it™ Fax Note 7671		Date 9-11-96	# of pages ▸ 2
To Samer Shururi		From Susan Flack	
Co./Dept. McL/H		Co. MHES	
Phone # 714-		Phone # 303-449-8471	
Fax # 714-756-8460		Fax #	

COMMENTS:

Ernie-
From our meeting with the air dispersion modelers, we have the following questions:

1. We need a release velocity, or the size of the area of ~~emissions~~ release (i.e., fan diameter) for Buildings 9201-5 and 9201-2 (Alpha 5 and Alpha 2) for the model. A guesstimate would be fine.

2. In your report for 9201-5 we cannot get 2% for 539,200 / 2,357,755. Please explain.

3. What would you estimate the error to be on the cfm flow rates (i.e., +/- x%)? We're thinking of an estimate based on professional judgement, not a quantitative error analysis.

4. What would you guess as a temperature for the air coming out of the mercury recovery furnace in 81-10?

If you want to just type up something and fax it to my house I'll be there this evening (Thursday). Thanks!

Susan
Susan

From the desk of...

Susan Flack
Sr. Associate
MHES- ChemRisk
2870 Kalmia Ave., Suite 308
Boulder, CO 80301-5915

303-449-8471
Fax: 303-939-8318

CALL
Wiley

chk pkg. 1. steam plants
- exhaust velocity?
- avg/typical Loads (lbs. stm/hr)
- avg/typical when burned coal vs. gas?
- Hg content of coal?

8-21 2. EFPC flow rates > 1983?
p. — of the Hg TF rpt says, "

✓ 8-19
revise text, then Send in measurement method to Nicolas for unc. estimate.

Send Samer: 1. Draw "area source" on Y-12 map → 1986-92 Hg releases

mark steam plants too.

9201-5
9201-4
9204-4

2. revised s'sheet

9201-2
81-10 area
old Hg warehouse 9720-26
old flask emptying area under Bldg. ~~[illegible]~~ 9103
scrap yard
9202
9733-1
9733-2

CALL EEC
✓1. Q's from mtg.
✓2. 9201-4 ventilation cut in half note.
± 3%, 9201-2 ±%

A-5

bldg. height
emission pt. height
(area of release)
OR ~~fan~~ diameters ?
release velocities ?
average S+W

539,200 / 2,357,755 ≠ 2%

A-4

Sue - Fix A-4 St-Terms using EEC's report.

O.K.
avg. S+W

B-4

A-2
diameter OR velocity ?

81-10

O.K. (Temp ?)
steam

FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
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Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: E. E. Choat (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 8/19/96 Pages including this cover page -- 2

Message:
This is to transmit revision to table 3, Building 9201-4 report.

Except for the correction of two errors, I have not changed ventilation rates. As shown, the 1st and 4th quarter rates are 52.7% of the "Summer" rate – which is as designed.
winter

Are you thinking that the note on page 111 of Wilcox report means that the building was operated at ½ of the "winter" rate? That would be approximately ¼ of the "Summer" design rate.

I interrupted the note to mean that operation was in accordance with the design. If
NO you disagree, I will divided by two and recalculate.

E. E. Choat

The following information represents revised estimates of air losses by quarter in Building 9201-4.

Comment	Yr	Qtr.	Hg building avg. (mg/m^3)	Estimate of Hg exhausted (lb)
Operation begins	55	2	.10	858
		3	.25	2,144
		4	.25	2,144
New ventilation system complete*	56	1	.12	2,059
		2	.05	858
		3	.05	858
		4	.04	686
	57	1	.04	686
		2	.03	515
		3	.03	515
		4	.02	343
	58	1	.02	343
		2	.03	515
		3	.04	686
		4	.02	343
Exhaust rates cut in half during first and fourth quarters	59	1	.03	258
		2	.03	515
		3	.03	515
		4	.02	172
	60	1	.02	172
		2	.03	515
		3	.03	515
		4	.02	172
	1961	1	.02	172
		2	.02	343
		3	.02	172
		4	.02	343
	1962	1	.02	172
		2	.02	343
		3	.02	343
Operation ends		4	.02	172
TOTAL				18,447

*It is estimated that the ventilation system work in Building 9201-4 lagged a quarter behind that of Building 9201-5.

Calculation for Hg Exhausted to Atmosphere from Building 9201-5

Year	Qtr.	Exhaust Cfm	m^3/day	Conc. mg/m^3	Effluent mg/day	grams/day	lbs/day	1bs/qtr	Wilcox Report 1bs/qtr
1955	1	1308545	53363512	0.20	10672702	10672.7	23.53	2118	1716
	2	1308545	53363512	0.15	8004527	8004.5	17.65	1588	1287
	3	1308545	53363512	0.31	16542689	16542.7	36.47	3282	2573
	4	1308545	53363512	0.21	11206338	11206.3	24.71	2223	3603
						Annual	Totals	9212	9179
1956	1	1684410	68691587	0.12	8242990	8243.0	18.17	1636	1888
	2	2357755	96151135	0.10	9615114	9615.1	21.20	1908	1716
	3	2357755	96151135	0.09	8653602	8653.6	19.08	1717	1544
	4	1684410	68691587	0.06	4121495	4121.5	9.09	818	1029
						Annual	Totals	6078	6177
1957	1	1684410	68691587	0.04	2747663	2747.7	6.06	545	686
	2	2357755	96151135	0.04	3846045	3846.0	8.48	763	686
	3	2357755	96151135	0.03	2884534	2884.5	6.36	572	515
	4	1684410	68691587	0.02	1373832	1373.8	3.03	273	343
						Annual	Totals	2153	2230
1958	1	1684410	68691587	0.02	1373832	1373.8	3.03	273	343
	2	2357755	96151135	0.02	1923023	1923.0	4.24	382	343
	3	2357755	96151135	0.02	1923023	1923.0	4.24	382	343
	4	1684410	68691587	0.03	2060748	2060.7	4.54	409	343
						Annual	Totals	1445	1372
1959	1	1684410	68691587	0.04	2747663	2747.7	6.06	545	515
	2	471551	19230227	0.05	961511.4	961.5	2.12	191	
	3	471551	19230227	0.04	769209.1	769.2	1.70	153	
	4	336882	13738317	0.03	412149.5	412.1	0.91	82	
						Annual	Totals	970	--
1960	1	336882	13738317	0.03	343457.9	343.5	0.76	68	
	2	471551	19230227	0.04	769209.1	769.2	1.70	153	
	3	471551	19230227	0.05	961511.4	961.5	2.12	191	
	4	336882	13738317	0.03	412149.5	412.1	0.91	82	
						Annual	Totals	493	--
						Total for all years		~~20896~~ 20351	19473 ✓

Notes:
1. Assumes "Winter" ventilation rates for 1st & 4th quarter.
2. Assumes "Summer" ventilation rates for 2nd & 3rd quarter.
3. Hg concentrations taken from "Wilcox" report, pg 110, with minor corrections by Susan Flack.
4. When process was shut down, ventilation was reduced to minimum as dictated by concentration level. It is estimated that the standby ventilation was 20% of the design rate.

Calculation for Hg Exhausted to Atmosphere from Building 9201-5									
									Wilcox
Year		Exhaust		Conc.	Effluent				Report
	Qtr.	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day	1bs/qtr	1bs/qtr
1955	1	1308545	53363512	0.20	10672702	10672.7	23.53	2118	1716
	2	1308545	53363512	0.15	8004527	8004.5	17.65	1588	1287
	3	1308545	53363512	0.31	16542689	16542.7	36.47	3282	2573
	4	1308545	53363512	0.21	11206338	11206.3	24.71	2223	3603
						Annual	Totals	9212	9179
1956	1	1684410	68691587	0.12	8242990	8243.0	18.17	1636	1888
	2	2357755	96151135	0.10	9615114	9615.1	21.20	1908	1716
	3	2357755	96151135	0.09	8653602	8653.6	19.08	1717	1544
	4	1684410	68691587	0.06	4121495	4121.5	9.09	818	1029
						Annual	Totals	6078	6177
1957	1	1684410	68691587	0.04	2747663	2747.7	6.06	545	686
	2	2357755	96151135	0.04	3846045	3846.0	8.48	763	686
	3	2357755	96151135	0.03	2884534	2884.5	6.36	572	515
	4	1684410	68691587	0.02	1373832	1373.8	3.03	273	343
						Annual	Totals	2153	2230
1958	1	1684410	68691587	0.02	1373832	1373.8	3.03	273	343
	2	2357755	96151135	0.02	1923023	1923.0	4.24	382	343
	3	2357755	96151135	0.02	1923023	1923.0	4.24	382	343
	4	1684410	68691587	0.03	2060748	2060.7	4.54	409	343
						Annual	Totals	1445	1372
1959	1	1684410	68691587	0.04	2747663	2747.7	6.06	545	515
	2	471551	19230227	0.05	961511.4	961.5	2.12	191	
	3	471551	19230227	0.04	769209.1	769.2	1.70	153	
	4	336882	13738317	0.03	412149.5	412.1	0.91	82	
						Annual	Totals	970	--
1960	1	336882	13738317	0.03	343457.9	343.5	0.76	68	
	2	471551	19230227	0.04	769209.1	769.2	1.70	153	
	3	471551	19230227	0.05	961511.4	961.5	2.12	191	
	4	336882	13738317	0.03	412149.5	412.1	0.91	82	
						Annual	Totals	493	--
						Total for all years		20896	19473

Notes:
1. Assumes "Winter" ventilation rates for 1st & 4th quarter.
2. Assumes "Summer" ventilation rates for 2nd & 3rd quarter.
3. Hg concentrations taken from "Wilcox" report, pg 110, with minor corrections by Susan Flack.
4. When process was shut down, ventilation was reduced to minimum as dictated by concentration level. It is estimated that the standby ventilation was 20% of the design rate.

Refers to pp. 107-111 in Y/EX-21/del rev.

Year	A5 air conc	Little air	Little lbs	days in 1/4	A5 Lbs		A5 Yr Total	A4 air conc	A4 Lbs		A4 Yr Total
1955	0.20	0.12	11.25	91.5	1716		9264		0		7463
	0.15	0.12	11.25	91.5	1287			0.13	1115	*	
	0.31	0.12	11.25	91.5	2659	*		0.26	2230	*	
	0.21	0.12	22.5	91.5	3603			0.24	4118	*	
1956	0.12	0.12	22.5	91.5	2059	*	6348	0.12	2059		4461
	0.10	0.12	22.5	91.5	1716			0.05	858		
	0.09	0.12	22.5	91.5	1544			0.05	858		
	0.06	0.12	22.5	91.5	1029			0.04	686		
1957	0.04	0.12	22.5	91.5	686		2230	0.04	686		2059
	0.04	0.12	22.5	91.5	686			0.03	515		
	0.03	0.12	22.5	91.5	515			0.03	515		
	0.02	0.12	22.5	91.5	343			0.02	343		
1958	0.02	0.12	22.5	91.5	343		1544	0.02	343		1887
	0.02	0.12	22.5	91.5	343			0.03	515		
	0.02	0.12	22.5	91.5	343			0.04	686		
	0.03	0.12	22.5	91.5	515	*		0.02	343		
1959	0.04	0.12	22.5	91.5	686	*	2745	0.03	515		1887
	0.05	0.12	22.5	91.5	858	*		0.03	515		
	0.04	0.12	22.5	91.5	686	*		0.03	515		
	0.03	0.12	22.5	91.5	515	*		0.02	343		
1960	0.03	0.12	22.5	91.5	429	*	2488	0.02	343		1716
	0.04	0.12	22.5	91.5	686	*		0.03	515		
	0.05	0.12	22.5	91.5	858	*		0.03	515		
	0.03	0.12	22.5	91.5	515	*		0.02	343		
1961		0.12	22.5	91.5	0			0.02	343		1373
		0.12	22.5	91.5	0			0.02	343		
		0.12	22.5	91.5	0			0.02	343		
		0.12	22.5	91.5	0			0.02	343		
1962		0.12	22.5	91.5	0			0.02	343		1373
		0.12	22.5	91.5	0			0.02	343		
		0.12	22.5	91.5	0			0.02	343		
		0.12	22.5	91.5	0			0.02	343		
											TOTAL
					24619		24619		22217		22217
					19473				18447		
					~~-21%~~				~~17%~~		
					-26				-20		
							46837	SMF			
							37920	Y/EX-21			
							-19%	error			

revised 9/3/96

* EEC cfm results for A-4 NOT included in these lbs. numbers.

① Could you revise Table 3 in 9201-4 report and fax/and mail to me?

② Could you make a table like Table 3 in 9201-4 report (attached) for 9201-5 showing lbs. Hg/quarter in effluent?

Qaairadd.xls

Falter ~~select~~ app. tables(s) Little's ~~1000~~ data .xls ? and Excel chart no's.

Year	A5 air conc	Little air	Little lbs	days in 1/4	A5 Lbs		A5 Yr Total	A4 air conc	A4 Lbs		A4 Yr Total
	Y/EX-21							Y/EX-21			
1955	0.20	0.12	11.25	91.5	1716		9264		0		7463
	0.15	0.12	11.25	91.5	1287			0.13	1115	*	
	.30 0.31	0.12	11.25	91.5	2659	*		0.26	2230	*	
	~~.11~~ 0.21	0.12	22.5	91.5	3603			0.24	4118	*	
1956	.11 0.12	0.12	22.5	91.5	2059	*	6348	0.12	2059		4461
	0.10	0.12	22.5	91.5	1716			0.05	858		
	0.09	0.12	22.5	91.5	1544			0.05	858		
	0.06	0.12	22.5	91.5	1029			0.04	686		
1957	0.04	0.12	22.5	91.5	686		2230	0.04	686		2059
	0.04	0.12	22.5	91.5	686			0.03	515		
	0.03	0.12	22.5	91.5	515			0.03	515		
	0.02	0.12	22.5	91.5	343			0.02	343		
1958	0.02	0.12	22.5	91.5	343		1544	0.02	343		1887
	0.02	0.12	22.5	91.5	343			0.03	515		
	0.02	0.12	22.5	91.5	343			0.04	686		
	.02 0.03	0.12	22.5	91.5	515	**		0.02	343		
1959	opens .03 0.04	0.12	22.5	91.5	686	*	2745	0.03	515		1887
	0.05	0.12	22.5	91.5	858	*		0.03	515		
	SMF added 0.04	0.12	22.5	91.5	686	*		0.03	515		
	0.03	0.12	22.5	91.5	515	*		0.02	343		
1960	0.03	.025 0.12	22.5	91.5	429	*	2488	.3 0.02	343		1716
	0.04	0.12	22.5	91.5	686	*		-.025 0.03	515		
	0.05	0.12	22.5	91.5	858	*		0.03	515		
	0.03	0.12	22.5	91.5	515	**		0.02	343		
1961		0.12	22.5	91.5	0			0.02	343		1373
		0.12	22.5	91.5	0			0.02	343		
		0.12	22.5	91.5	0			0.02	343		
		0.12	22.5	91.5	0			0.02	343		
1962		0.12	22.5	91.5	0			0.02	343		1373
		0.12	22.5	91.5	0			0.02	343		
		0.12	22.5	91.5	0			0.02	343		
		0.12	22.5	91.5	0			0.02	343		
											TOTAL
				TOTALS	24619		24619	TOTALS	22217		22217
				Y/EX-21	19473	✓		Y/EX-21	18447	✓	
					-26%				-20%		
							46837	conc changes			
							37920	Y/EX-21			
							-24%	~~error~~ difference			
Notes											
* = air conc revised from Y/EX-21/del rev					~~20351~~	19923	~~53449~~	vent and conc	~~33098~~		33262
					~~-4%~~	-2%		changes	~~-79%~~		-80 %

corrected for ~~[illegible]~~

* discrepancy betw. IH reports and Y/EX-21 (4-1y reports) ~~[illegible]~~ (LaFrance 1957, 1958)

19923
\+ 33262 (or 33098) Δ164
53185 (or 53021)

~~AND~~

** addtnl. data located in IH list reports 1960

date for sec B all
2: 3/13 1:42 p
2:08 p

FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Copy

Phone: 303 449 8471 Fax:303 939 8318

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Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 9/7/96 Pages including this cover page --3

This is to transmit:
1. Revision 2 of Table 3 of building 9201-4 report.
2. Revision 1 to "Calculation for Hg Exhausted to Atmosphere from building 9201-5."
3. Provide roof elevations --- building 9204-4 --- figure 1 of Report.

- ✓ Elevation of the lowest roof is 1028' 6"
- ✓ Elevation of 2nd lowest roor is 1048' 9 7/8"
- ✓ High Roof is 1061' 3 ¾"

I should revise this drawing to show stacks and these elevations but have already blown all of my hours. In fact, I have now 39 hours past the limit – 20 hours in July and 19 hours in August.

E. E. Choat

FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: E. E. Choat (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 9/7/96 Pages including this cover page --3

This is to transmit:
1. Revision 2 of Table 3 of building 9201-4 report.
2. Revision 1 to "Calculation for Hg Exhausted to Atmosphere from building 9201-5."
3. Provide roof elevations --- building 9204-4 --- figure 1 of Report.

- Elevation of the lowest roof is 1028' 6"
- Elevation of 2nd lowest roor is 1048' 9 7/8"
- High Roof is 1061' 3 ¾"

I should revise this drawing to show stacks and these elevations but have already blown all of my hours. In fact, I have now 39 hours past the limit -- 20 hours in July and 19 hours in August.

E. E. Choat

FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: **E. E. Choat** (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 9/7/96 Pages including this cover page --3

This is to transmit:
1. Revised Table 3 of building 9201-4 report.
2. Calculation for Hg Exhausted to Atmosphere from building 9201-5.

E. E. Choat

Table 3
Calculation of Pounds of Mercury per Quarter Exhausted to Atmosphere from 9201-4

Year		Exhaust	Exhaust	Conc.	Effluent				Wilcox Report
1955	Qtr.	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day	1bs/qtr	1bs/qtr
	2	2050740	83630818	0.1	8363082	8363.1	18.44	1659	858
	3	2050740	83630818	0.25	2.1E+07	20907.7	46.09	4148	2144
	4	1446429	58986532	0.25	1.5E+07	14746.6	32.51	2926	2144
							Totals	8733	5146
1956	1	1446429	58986532	0.12	7078384	7078.4	15.60	1404	2059
	2	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	3	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	4	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
							Totals	6012	4461
1957	1	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	3487	2059
1958	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.04	7671749	7671.7	16.91	1522	686
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	3466	1887
1959	1	2477380	101029538	0.03	3030886	3030.9	6.68	601	258
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	3286	1460
1960	1	2477380	58986532	0.02	1179731	1179.7	2.60	234	172
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	2919	1374
1961	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	172
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	2324	1030
1962	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	2324	1030
					Totals	for all	years	~~32382~~	18447

401-234 =
167

32384
+167
32551

So you can see what cfms E. Choat used.

---

① In Table 3 "new" (9201-4), the numbers for air conc. are not changed, but it appears that the calc's changed compared to the previous version you sent me. (see both Table 3 "old" and Table 3 "new" attached).

② In Sheet 1 (9201-5) and Table 3 "new", my totals for all years do not agree with your numbers.

Help!

Post-it™ Fax Note 7671		Date 9-10-96	# of pages ▶ 4
To Ernie Choat		From Susan Flack	
Co./Dept.		Co.	
Phone #		Phone # 303-449-8471	
Fax # 423-482-2605		Fax #	

Have not heard back yet (9-11-96 4 pm).

Table 3 old

Calculation of Pounds of Mercury per Quarter Exhausted to Atmosphere from 9201-4

	Year		Exhaust		Conc.		Effluent			Wilcox Report	
	1955	Qtr.	Cfm	m³/day	mg/m³	mg/day	grams/day	lbs/day	1bs/qtr	1bs/qtr	lbs/yr
		2	2050740	83630818	~~0.1~~ .13	8363082	8363.1	18.44	1659	858	
		3	2050740	83630818	~~0.25~~ .24	2.1E+07	20907.7	46.09	4148	2144	
		4	1446429	58986532	~~0.25~~ .24	1.5E+07	14746.6	32.51	2926	2144	8733
	1956	1	1446429	58986532	0.12	7078384	7078.4	15.60	1404	2059	
		2	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858	
		3	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858	
		4	2477380	101029538	0.04	4041182	4041.2	8.91	802	686	6012
	1957	1	2477380	101029538	0.04	4041182	4041.2	8.91	802	686	
		2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515	
		3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515	
		4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343	3487
	1958	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	343	
		2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515	
		3	4703040	191793734	0.04	7671749	7671.7	16.91	1522	686	
		4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343	3466
*	1959	1	2477380	101029538	0.03	3030886	3030.9	6.68	601	258	
		2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515	
		3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515	
*		4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172	3286
See note on p. of Y/EX-21	1960	1	1446429	58986532	0.02	1179731	1179.7	2.60	234	172	
		2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515	
		3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515	
		4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172	2979
	1961	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172	
		2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343	
		3	4703040	191793734	0.02	3835875	3835.9	8.46	761	172	
		4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343	2324
	1962	1	1446429	58986532	0.02	1179731	1179.7	2.60	234	172	
		2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343	
		3	4703040	191793734	0.02	3835875	3835.9	8.46	761	343	
		4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172	2157
								Totals	32382	18447	

32384

$$\begin{array}{r} 2324 \\ -2157 \\ \hline 167 \end{array}$$

9

new

Table 3

Calculation of Pounds of Mercury per Quarter Exhausted to Atmosphere from 9201-4

Year		Exhaust	Exhaust	Conc.	Effluent				Wilcox Report
1955	Qtr.	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day	1bs/qtr	1bs/qtr
	2	2050740	83630818	~~0.1~~ .13	1087201	10872.0	23.97	2157	858
	3	2050740	83630818	~~0.25~~ .26	2174401	21744.0	47.94	4314	2144
	4	1446429	58986532	~~0.25~~ .24	1415677	14156.8	31.21	2809	2144
							Totals	9280	5146
1956	1	1446429	58986532	0.12	7078384	7078.4	15.60	1404	2059
	2	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	3	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	4	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
							Totals	6012	4461
1957	1	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	3487	2059
1958	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.04	7671749	7671.7	16.91	1522	686
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	3466	1887
1959	1	2477380	101029538	0.03	3030886	3030.9	6.68	601	258
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	3286	1460
1960	1	2477380	58986532	0.02	1179731	1179.7	2.60	234	172
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	2919	1374
1961	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	172
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	2324	1030
1962	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	2324	1030
					Totals	for all	years	~~32382~~ ✓33098	18447

9280
− 8733
547

✓ 32551
+ 547
33098

Table 3
Calculation of Pounds of Mercury per Quarter Exhausted to Atmosphere from 9201-4

Year		Exhaust	Exhaust	Conc.	Effluent				Wilcox Report
1955	Qtr.	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day	1bs/qtr	1bs/qtr
	2	2050740	83630818	0.1	1087201	10872.0	23.97	2157	858
	3	2050740	83630818	0.25	2174401	21744.0	47.94	4314	2144
	4	1446429	58986532	0.25	1415677	14156.8	31.21	2809	2144
							Totals	9280	5146
1956	1	1446429	58986532	0.12	7078384	7078.4	15.60	1404	2059
	2	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	3	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	4	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
							Totals	6012	4461
1957	1	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	3487	2059
1958	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.04	7671749	7671.7	16.91	1522	686
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	3466	1887
1959	1	2477380	101029538	0.03	3030886	3030.9	6.68	601	258
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	3286	1460
1960	1	2477380	58986532	0.02	1179731	1179.7	2.60	234	172
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	2919	1374
1961	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	172
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
							Totals	2324	1030
1962	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
							Totals	2324	1030
					Totals	for all	years	~~32382~~ 33098	18447

hatoatnl.xls

Table 3
Calculations of Pounds of Mercury per Quarter Exhausted to Atmosphere from 9201-4

40.781 m³/ft³ 35.31   1440 min/d   453.59   90d

Year	Qtr.	Exhaust Cfm	Exhaust m³/day	Conc. mg/m³	Effluent mg/day	Effluent grams/day	Effluent lbs/day	Effluent 1bs/qtr	Wilcox Report 1bs/qtr
1955	2	2050740	83630818	0.13	10872006	10872.0	23.97	2157	858
	3	2050740	83630818	0.26	21744013	21744.0	47.94	4314	2144
	4	1446429	58986532	0.24	14156768	14156.8	31.21	2809	2144
								9280	5146
1956	1	1446429	58986532	0.12	7078384	7078.4	15.60	1404	2059
	2	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	3	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	4	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
								6012	4461
1957	1	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
								3486	2059
1958	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.04	7671749	7671.7	16.91	1522	686
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
								3466	1887
1959	1	2477380	101029538	0.03	3030886	3030.9	6.68	601	258
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
								3286	1460
1960	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
								3085	1374
1961	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	172
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
								2324	1030
1962	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
								2324	1030
							Totals	33262	18447

-1

1142 - 952 = 190 (6025)

-2919 = Δ166

✓ ok.

Notes:
1. Assumes "Winter" ventilation rates for 1st & 4th quarter.
2. Assumes "Summer" ventilation rates for 2nd & 4th quarter.
3. Hg concentrations taken from "Wilcox" report, page 111.

33098
+ 165
33263

Δ164

Table 3
Calculations of Pounds of Mercury per Quarter Exhausted to Atmosphere from 9201-4

Year		Exhaust		Conc.	Effluent				Wilcox Report
	Qtr.	Cfm	m^3/day	mg/m^3	mg/day	grams/day	lbs/day	1bs/qtr	1bs/qtr
1955	2	2050740	83630818	0.13	10872006	10872.0	23.97	2157	858
	3	2050740	83630818	0.26	21744013	21744.0	47.94	4314	2144
	4	1446429	58986532	0.24	14156768	14156.8	31.21	2809	2144
								9280	5146
1956	1	1446429	58986532	0.12	7078384	7078.4	15.60	1404	2059
	2	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	3	4703040	191793734	0.05	9589687	9589.7	21.14	1903	858
	4	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
								6012	4461
1957	1	2477380	101029538	0.04	4041182	4041.2	8.91	802	686
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
								3486	2059
1958	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.04	7671749	7671.7	16.91	1522	686
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
								3466	1887
1959	1	2477380	101029538	0.03	3030886	3030.9	6.68	601	258
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020 6	4.45	401	172
								3286	1460
1960	1	2477380	101029538	0.02	2020591	2020 6	4.45	401	172
	2	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	3	4703040	191793734	0.03	5753812	5753.8	12.68	1142	515
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
								3085	1374
1961	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	172
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	343
								2324	1030
1962	1	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
	2	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	3	4703040	191793734	0.02	3835875	3835.9	8.46	761	343
	4	2477380	101029538	0.02	2020591	2020.6	4.45	401	172
								2324	1030
							Totals	33262	18447

Notes:
1. Assumes "Winter" ventilation rates for 1st & 4th quarter.
2. Assumes "Summer" ventilation rates for 2nd & 4th quarter.
3. Hg concentrations taken from "Wilcox" report, page 111.

Sheet1

Calculation for Hg Exhausted to Atmosphere from Building 9201-5

Year	Qtr.	Exhaust Cfm	m^3/day	Conc. mg/m^3	Effluent mg/day	grams/day	lbs/day	1bs/qtr	Wilcox Report 1bs/qtr
1955	1	1308545	53363512	0.20	10672702	10672.7	23.53	2118	1716
	2	1308545	53363512	0.15	8004527	8004.5	17.65	1588	1287
	3	1308545	53363512	0.31	16542689	16542.7	36.47	3282	2573
	4	1308545	53363512	0.21	11206338	11206.3	24.71	2223	3603
						Annual	Totals	9212	9179
1956	1	1684410	68691587	0.12	8242990	8243.0	18.17	1636	1888
	2	2357755	96151135	0.10	9615114	9615.1	21.20	1908	1716
	3	2357755	96151135	0.09	8653602	8653.6	19.08	1717	1544
	4	1684410	68691587	0.06	4121495	4121.5	9.09	818	1029
						Annual	Totals	6078	6177
1957	1	1684410	68691587	0.04	2747663	2747.7	6.06	545	686
	2	2357755	96151135	0.04	3846045	3846.0	8.48	763	686
	3	2357755	96151135	0.03	2884534	2884.5	6.36	572	515
	4	1684410	68691587	0.02	1373832	1373.8	3.03	273	343
						Annual	Totals	2153	2230
1958	1	1684410	68691587	0.02	1373832	1373.8	3.03	273	343
	2	2357755	96151135	0.02	1923023	1923.0	4.24	382	343
	3	2357755	96151135	0.02	1923023	1923.0	4.24	382	343
	4	1684410	68691587	0.03	2060748	2060.7	4.54	409	343
						Annual	Totals	1445	1372
1959	1	1684410	68691587	0.04	2747663	2747.7	6.06	545	515
	2	471551	19230227	0.05	961511.4	961.5	2.12	191	
	3	471551	19230227	0.04	769209.1	769.2	1.70	153	
	4	336882	13738317	0.03	412149.5	412.1	0.91	82	
						Annual	Totals	970	-
1960	1	336882	13738317	0.03	343457.9	343.5	0.76	68	
	2	471551	19230227	0.04	769209.1	769.2	1.70	153	
	3	471551	19230227	0.05	961511.4	961.5	2.12	191	
	4	336882	13738317	0.03	412149.5	412.1	0.91	82	
						Annual	Totals	493	-
						Total for all years		20351	19473

Notes:

1. Assumes "Winter" ventilation rates for 1st & 4th quarter.
2. Assumes "Summer" ventilation rates for 2nd & 3rd quarter.
3. Hg concentrations taken from "Wilcox" report, pg 110, with minor corrections by Susan Flack.
4. When process was shut down, ventilation was reduced to minimum as dictated by concentration level. It is estimated that the standby ventilation was 20% of the design rate

FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: **E. E. Choat** (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 11/1/96 Pages including this cover page --1

Message:
Can handle files on floppy. Call me when you get here.

E. E. Choat

C O V E R

S H E E T

FAX

To: Ernie Choat
Fax #: 423-482-2605
Subject: Y-12 Ventilation Project
Date: October 31, 1996
Pages: 1, including this cover sheet.

COMMENTS:

Hi Ernie!

I wanted to ask you two questions. (1) Could you give me your Word document(s) and Excel files on a diskette? I have to convert them to our software and format for an appendix for our report. I need the Excel files for the QA notebook where we have to provide documentation of all calculations. (2) I was able to calculate quarterly average air concentrations of mercury for Alpha-2 and Beta-4 for April 1955 through December 1959. Since you are over on hours, I was wondering if I could make a couple of Excel tables like you did for A-5 and A-4 to calculate the pounds of mercury emitted from the buildings, and then you could look them over and bless them.

I'll be in Oak Ridge at the Comfort Inn all next week.

Susan
Susan Flack

From the desk of...

Susan Flack
Senior Associate Health Scientist
MHES
2870 Kalmia Ave. Suite 308
Boulder, CO 80301-5915

303-449-8471
Fax: 303-939-8318

COVER SHEET

FAX

To: Ernie Choat
Fax #: 423-483-6062
Subject: Alpha 2 Building Air
Date: February 5, 1997
Pages: 7, including this cover sheet.

COMMENTS:

Hi Ernie!

I found this memo in my piles of paper from Steve Wiley and I don't think I showed it to you. Would you take a quick look at it and see if it changes anything you've assumed about Alpha-2 building ventilation? Only call me back if it does.

Thanks!

Susan

Susan

From the desk of...

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FACSIMILE COVER SHEET

To: Susan M. Flack
ChemRisk
2870 Kalmia Avenue, Suite 308
Boulder, CO 80301

Phone: 303 449 8471 Fax:303 939 8318

From: **E. E. Choat** (EEC)
Company: Environmental Engineering Consultants (EEC)
Phone: 615 483 6062 Fax:423 482 2605

Date: 1/20/97 Pages including this cover page --2

This is to transmit:
1. Revised Table 1, page 5 of building 9201-5 report.

The numbers in Table 1 that you questioned still make no sense to me. Since I was unable to determine the source of these numbers from spread sheet calculations, I have gone back to the drawings to revise table 1.

You will observe that "Contaminated Exh from Building" is still unequal to "Fresh Air Supply". The difference results from 157800 cfm of "uncontaminated" air that is exhausted from the Maintenance area.

Then: 1,526,610 + 157,800 = 1,644,410 which equals fresh air supply

E. E. Choat

C O V E R

S H E E T

FAX

To: Ernie Choat
Fax #: 423-482-2605
Subject: Change in A-5 ventilation
Date: January 22, 1997
Pages: 5, including this cover sheet.

COMMENTS:

Hi! Thanks for checking the ventilation drawings for A-5. I got your table and revised the A-5 winter ventilation rate in 3 places: (1) the Sheet 1 calculation table of pounds released per quarter in the A-5 report; (2) a little summary table on p. 4 of the A-5 report; and (3) a little summary table on p. 8 of the A-4 report. It did not change anything in Table 4 of the A-5 report, which defines fan locations, winter air volumes, % of total exhaust volume, and exhaust point locations.

I'm sending you these revisions for your records- I don't expect you to recalculate any numbers. I also included a copy of my summary table for all air releases from all buildings FYI.

Thanks again!

Susan

Susan Flack

From the desk of...

Susan Flack
Senior Associate Health Scientist
MHES
2870 Kalmia Ave. Suite 308
Boulder, CO 80301-5915

303-449-8471
Fax: 303-939-8318

INTER OFFICE MEMO

To: Samir Sururi (Irvine)
From: Susan Flack (Alameda)
Subject: Oak Ridge Task 2 Air Dispersion Modeling
Date: January 23, 1997

I met with Ernie Choat last week in Oak Ridge. As a result of one of my questions, he made some changes to his winter ventilation volume for Building 9201-5 that changed his calculation of pounds of mercury emitted from A-5 per year. Therefore I had to change everything in the chain again. It didn't, however, change the winter volumes for the emissions sources from A-5. I am going to attempt to type a list of all the changes to the air dispersion modeling, including ones we already discussed in Alameda and a few more changes per Ernie. Note that the marked-up table I gave you a copy of in Alameda has been further changed (and I took back some of my suggested changes per your and Ernie's opinions), so don't rely on that. I have also attached (in email) the Excel file called 'airlbs.xls' for you to use as a source of the final estimates of pounds of mercury released from each facility for every applicable year. Hurrah!

1. For 9201-4 building, add 3 emission sources to the roof for:

[591380 cfm (24%) for winter// 590240 cfm (13%) for summer] from 1st and 2nd floors- Ernie said this is a duct type source; assume 8 of them and the area for each one would be annual avg cfm/ 2200/ 8.

[428800 cfm (17%) for winter// 428880 (9%) for summer] from tray exhaust- Ernie said this is a centrifugal fan type source; assume 4 of them and the area for each one would be 107200/ 2200.

[104000 cfm (4%) for winter// 104000 cfm (2%) for summer] from roof exhausters- Ernie said this is a centrifugal fan type source; assume 4 of them and the area for each one would be 26000/ 2200.

References are Tables 4&5 (Building exhaust summaries for summer and winter) and Figure 3 (3rd floor plan) in Ernie's 9201-4 report.

2. Change elevations above ground level for S9201-41 thru -48, and S9201-51 thru -58, to 88', not 93'. Leave all of these fan diameters at 54" (Ernie said to pass along to you that all these fans had only one speed; to reduce flow they just had to turn some fans off.)

Ernie's Tables 4 and 5 *should* show the elevation above sea level for the 9201-4 roof sources to be 1051' (roof level), not 1056. However, if they don't physically fit on the roof at 1051', the 4 roof exhausters and the 8 ducts from the 1st and 2nd floors could be placed on the lower roof at 1040' like they are in 9201-5 (see Figure 2 in Ernie's 9201-5 report). He doesn't have drawings that show these roof sources on 9201-4. Ernie followed a general rule of thumb for roof source elevations in all buildings except for the one case of the upper roof of 9201-4 (he said the elevation of the upper roof was 1051 + 5 =1056). The general rule is to assume fan height above roof is 0 because we don't know the actual heights of any of these stacks/ducts and Ernie thinks it makes a difference of only a few feet anyway. (Note however that he put the wall fans in a space 8-9' down from the floor above.) So to be consistent, please change the roof elevations.

3. Correct a math error in the S9201-55 thru -58; volume flow rate for each should be 186000/ 4 =46550 not 46200.

4. Assume that the south and north wall louvers in 9201-5 above the east and west crane bays (F9201-54, -56, -513, -515, -525, -527, -528, -530) are 40' wide x 15' high. It appears that you assumed two louvers were side by side on each wall above each crane bay; make the total width at each of the 4 locations 80' somehow.

5. The elevation above ground level for S9201-59 thru -74 should be 67' not 72'. The diameter of 9201-59 thru-62, and -67 thru -70, should be larger- assume 72" instead of 54".

6. The elevation above ground level of F9204-41 thru -46 should be 65' (1061-6-990; in the wall space that's halfway between the 1049' and 1061' levels) not 60.5'. The elevation above ground level of S9204-41 and -42 should be 71' (1061-990) not 76'. The drawing showing the basement grade and the first floor grade was misleading

7. Add a building to the modeling, 9201-2.

I have attached a marked-up drawing and a handwritten table for this building. Ernie said again to divide the volume by the velocity to get the area, and therefore the diameter.

8. Correct two exhaust temperature errors.

S81-101exhaust temperature should be 200 F.
S9401-11 (-12 see next item), -21, -31, and -32 exhaust temperatures should be 300 F.

9. Add a stack to the 9401-1 steam plant, and change the diameters of both of the two stacks.

I found photos and a drawing that show two stacks instead of one. (Add S9401-12 to S9401-11.) Make the diameter of S9401-11 = 6' instead of 12.5', and the diameter of S9401-12 = 8', instead of 12.5'. The rest of the diameters stay the same.

10. The height of S81-101 should be 16' or 4.88 m, not 5.88 m. The height of S9401-31 and -32 should be 190', not 100'.

C O V E R

S H E E T

FAX

To: Samer Sururi

Fax #: 714-756-8460

Subject: Task 2 Air Modeling

Date: January 24, 1997

Pages: 8, including this cover sheet.

COMMENTS:

Too many already!

From the desk of...

Susan Flack
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exhaust direction / time of yr.

exhaust direction (N, S, E)

above sea level

? ~1 ft/m

SOURCES

above grade

$vfr = \vec{v} \times \frac{\pi d^2}{4}$

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
					ft (1050')		in	fpm	
S9201-41	187	747019.55	3985468.79	963' 0	~~93~~ 88	293.15	4.5' 54	2200	35000
S9201-42	186	747009.73	3985484.94	0	~~93~~		54	2200	
S9201-43	185	746999.91	3985501.08	0	~~93~~		54	2200	
S9201-44	184	746990.09	3985517.23	0	~~93~~		54	2200	
S9201-45	183	746933.27	3985416.30	0	~~93~~		54	2200	
S9201-46	182	746923.45	3985432.45	0	~~93~~		54	2200	
S9201-47	181	746913.63	3985448.60	0	~~93~~		54	2200	
S9201-48	180	746903.81	3985464.74	0	~~93~~		54	2200	
S9201-51	E 179	746783.36	3985336.40	973' 0	~~93~~ 88	(1061')	~~54~~	~~[illegible]~~	76000
S9201-52	E 178	746773.54	3985352.55	0	~~93~~		~~54~~		76000
S9201-53	E 177	746763.71	3985368.69	0	~~93~~		~~54~~		76000
S9201-54	E 176	746753.89	3985384.84	0	~~93~~		~~54~~		76000
S9201-55	W 175	746697.08	3985283.91	0	~~93~~		~~54~~	~~[illegible]~~	46550 ~~46200~~
S9201-56	W 174	746687.26	3985300.06	0	~~93~~		~~54~~		46550 ~~46200~~
S9201-57	W 173	746677.44	3985316.21	0	~~93~~		~~54~~		46550 ~~46200~~
S9201-58	W 171	746667.61	3985332.35	0	~~93~~		~~54~~		46550 ~~46200~~
S9401-11	146	748020.91	3986023.46	0	30.48 / 100	~~200~~ 300 °F	~~12.5FT~~ 6'	2200?	
S81-101	135	747175.14	3985329.55	4.88 ~~0~~	~~[illegible]~~ 16'	~~200~~ °F	1.167 14		1300
S9401-21	134	747083.59	3985385.07	0	30.48 / 100	300 ~~200~~ °F	~~12.5FT~~ ~~[illegible]~~ std	2200	
S9401-31	133	746929.02	3985306.16	57.9 0	~~100~~ 90	300 °F	12.5FT	2200	
S9401-32	132	746962.56	3985326.57	57.9 0	~~100~~ 90	300 °F	15FT	2200	
S9204-41	8	746501.30	3985191.05	990'? (1061', -990) 0	23.1676 71	293.15	6.75' 81	assumes ☐ is ○ 1667	60000
S9204-42	7	746524.04	3985204.88	0	23.1676 71	293.15	6.75' 81	1667	60000
F9201-41	~~124~~	746915.26	3985392.50	0	(1020')				
F9201-431	123 S	746917.16	3985393.65	0	17.38 57	293.15	6' 72	2483	70200 H
F9201-42	~~122~~	746919.06	3985394.81	0					
F9201-432	121 S	746920.96	3985395.96	0	57	293.15	6' 72	2483	70200 H
F9201-43	~~120~~	746922.86	3985397.12	0					
F9201-44	119 S	746936.94	3985396.41	0	57	293.15	9' 108	2248	143000 H
F9201-45	~~118~~	746943.10	3985400.16	0					
F9201-46	117 S	746949.25	3985403.90	0	57	293.15	9' 108	2248	143000 H

up S+W

why roof ventilators 8? assume = A-4?

Add S9401-12 8' diameter roof stack

add Door

20% of roof 9201-4

9201-4: 590,700 cfm from 1st, 2nd floors
428,800 from tray exhaust
104,000 from roof exhausters
80% of roof

Q: Should we include?

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
F9201-47	116 S	746959.21	3985409.96	0	(120') 57	293.15	6' 72	2483	70200
F9201-433	~~115~~	746961.12	3985411.12	0					
F9201-48	114 S	746963.02	3985412.27	0	57		6' 72	2483	70200
F9201-434	113 S	746964.92	3985413.43	0	57		72	2483	70200
F9201-49	112 S	746966.82	3985414.59	0	57		72	2483	70200
F9201-410	111 S	747005.66	3985438.21	0	57		72	2483	70200
F9201-435	~~110~~	747007.56	3985439.37	0					
F9201-411	109 S	747009.46	3985440.52	0	57		6' 72	2483	70200
F9201-436	108 S	747011.36	3985441.68	0	57		6' 72	2483	70200
F9201-412	107 S	747013.26	3985442.84	0	57		6' 72	2483	70200
F9201-413	106 S	747023.22	3985448.90	0	57		9' 108	2248	143000
F9201-414	~~105~~	747029.38	3985452.64	0					
F9201-415	104 S	747035.53	3985456.39	0	57	(100')	9' 108	2248	143000
F9201-416	103 E	747035.81	3985504.05	0	11.28 37		3.5' 42	2339	22500
F9201-417	102 E	747033.50	3985507.85	0	37		42	2339	22500
F9201-418	101 E	747031.19	3985511.65	0	37		42	2339	22500
F9201-419	100 E	747028.87	3985515.45	0	37		42	2339 X4	22500
F9201-420	99 E	747026.21	3985519.83	0	5.18 17	(980')	5' 60	2292	45000
F9201-421	98 E	747023.90	3985523.64	0	17		60	2292 X2	45000
F9201-422	~~97~~	747008.10	3985541.04	0					
F9201-437	96 N	747006.20	3985539.88	0	17.38 57		6' 72	2483	70200
F9201-423	95 N	747004.30	3985538.72	0	57		72	2483	70200
F9201-438	94 N	747002.40	3985537.57	0	57		72	2483	70200
F9201-424	93 N	747000.50	3985536.41	0	57		72	2483 X14	70200
F9201-425	92 N	746986.42	3985537.12	0	57		9' 108	2248	143000
F9201-426	~~91~~	746980.26	3985533.38	0					
F9201-427	90 N	746974.11	3985529.63	0	57		9' 108	2248	143000
F9201-428	89 N	746900.14	3985484.64	0	57		9' 108	2248	143000
F9201-429	~~88~~	746893.98	3985480.89	0					
F9201-430	87 N	746887.83	3985477.14	0	57		9' 108	2248 X8	143000
F9201-51	~~70~~	746679.06	3985260.11	0					

H

2483 cfm: 6-20 (W S) = 13 annual avg. S wall N wall 2 3 / 1 1 1.0 2.5 / 4 1

2339 cfm: 2-4 (W S) = 3 avg. E could delete 1

2248 cfm: 4-12 (W S) = 8 ann avg. S wall N wall 1 1 / 1 1 4 1 / 4 1

2292 cfm: 1-2 (W S) ≤ 1.5 avg

no diagram for these no's for A-5 (∴ S and N c/b reversed)

SOURCES

	STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER ~~(m)~~	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
	F9201-531	~~69~~	746680.97	3985261.26	0					
	F9201-52	~~68~~	746682.87	3985262.42	0					
	F9201-532	~~67~~	746684.77	3985263.58	0				assume fan size is proportional to vol flow rate	
	F9201-53	~~66~~	746686.67	3985264.73	0					
louver	F9201-54	SW ~~65~~ stet	746700.75	3985264.02	0	23.47 77 ✓	293.15	7.5' ~~90~~		✓ 89500
	F9201-55	~~64~~	746706.90	3985267.77	0					
louver	F9201-56	SW 63	746713.06	3985271.51	0	77 ✓	293.15	7.5' ~~90~~		✓ 89500
	F9201-57	~~62~~	746723.02	3985277.57	0					
	F9201-533	~~61~~	746724.92	3985278.73	0					
	F9201-58	~~60~~	746726.82	3985279.88	0					
	F9201-534	~~59~~	746728.72	3985281.04	0					
	F9201-59	~~58~~	746730.62	3985282.20	0					
	F9201-510	~~57~~	746769.46	3985305.82	0					
	F9201-535	~~56~~	746771.36	3985306.98	0					
	F9201-511	~~55~~	746773.26	3985308.14	0					
	F9201-536	~~54~~	746775.16	3985309.29	0					
	F9201-512	~~53~~	746777.07	3985310.45	0					
louver	F9201-513	SE 52	746787.03	3985316.51	0	77 ✓	293.15	7.5' ~~90~~	~~[illegible]~~ ~~60~~	✓ 45300
louver	F9201-514	~~51~~	746793.18	3985320.25	0					
	F9201-515	SE 50	746799.34	3985324.00	0	77 ✓	293.15	7.5' ~~90~~	~~[illegible]~~ ~~60~~	✓ 45300
	F9201-516	~~49~~	746799.62	3985371.66	0					
	F9201-517	~~48~~	746797.30	3985375.46	0					
	F9201-518	~~46~~	746795.00	3985379.27	0					
	F9201-519	~~45~~	746792.68	3985383.07	0					
	F9201-520	~~44~~	746790.02	3985387.44	0					
	F9201-521	~~43~~	746787.70	3985391.25	0					
	F9201-522	~~42~~	746771.91	3985408.65	0					
	F9201-537	~~41~~	746770.01	3985407.49	0					
	F9201-523	~~40~~	746768.11	3985406.33	0					
	F9201-538	~~39~~	746766.21	3985405.18	0					
	F9201-524	~~38~~	746764.30	3985404.02	0					

louver = no velocity?
Q: why 2 on each N and S wall? side by side?
crane bay is 95' across - diagram suggest 57' across - so why assume 15'? (or 10'?) louver is

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
F9201-525	NE 37	746750.23	3985404.73	0	77	293.15	7.5' ~~90~~	~~260~~	45300
F9201-526	~~36~~	746744.07	3985400.99	0					
F9201-527	NE 35	746737.91	3985397.24	0	77	293.15	~~90~~	~~260~~	45300
F9201-528	NW 34	746663.95	3985352.25	0	77	293.15	~~90~~		89500
F9201-529	N 33	746657.79	3985348.50	0	11.28 37	293.15	3.5' 60	2037 ?2200	40000
F9201-530	NW 32	746651.63	3985344.75	0	77	293.15	7.5 ~~90~~		89500
V9204-41	17	746541.31	3985232.83	0	21.64 71	293.15	3' 36	2829	20000
V9204-42	16	746532.51	3985227.47	0	71	293.15	36	2829	20000
V9204-43	15	746523.29	3985221.87	0	71	293.15	36	3508	24800
V9204-44	14	746514.20	3985216.33	0	71	293.15	36	2829	20000
V9204-45	13	746504.99	3985210.73	0	71	293.15	36	3508	24800
V9204-46	12	746496.06	3985205.30	0	71	293.15	36	2829	20000
V9204-47	11	746486.85	3985199.69	0	71	293.15	36	3508	24800
V9204-48	10	746477.75	3985194.16	0	71	293.15	36	2829	20000
V9204-49	9	746468.54	3985188.56	0	71	293.15	36	2829	20000
F9204-41	S 6	746489.9	3985184.1	0	18.4 ~~60.5~~ 65	293.15	5' 60	2037	40000
F9204-42	S 5	746512.7	3985198	0	~~60.5~~ 65	293.15	60	2037	40000
F9204-43	S 4	746535.4	3985211.8	0	~~60.5~~ 65	293.15	60	2037	40000
F9204-44	N 3	746519.9	3985237.3	0	~~60.5~~ 65	293.15	60	2037	40000
F9204-45	N 2	746497.2	3985223.4	0	~~60.5~~ 65	293.15	60	2037	40000
F9204-46	N 1	746474.4	3985209.6	0	~~60.5~~ 65	293.15	60	2037	40000
S9201-59	W	746647.7	3985320.24	0	~~72~~ 67	293.15	4.5' ~~54~~	72	75355
S9201-60	W	746657.52	3985304.09	0	~~72~~	293.15	~~54~~		75355
S9201-61	W	746667.34	3985287.94	0	21.95 ~~72~~	293.15	~~54~~		75355
S9201-62	W	746677.16	3985271.80	0	~~72~~	293.15	~~54~~		75355
S9201-63	WC	746687.56	3985344.49	0	~~72~~	293.15	4' 108		114223.13
S9201-64	WC	746697.38	3985328.34	0	~~72~~	293.15	108		114223.13
S9201-65	WC	746707.20	3985312.19	0	~~72~~	293.15	108		114223.13
S9201-66	WC	746717.03	3985296.05	0	~~72~~	293.15	108		114223.13
S9201-67	EC	746733.94	3985372.71	0	~~72~~	293.15	4.5' ~~54~~	?72	64267.5
S9201-68	EC	746743.77	3985356.56	0	~~72~~	293.15	6 ~~54~~	72	64267.5

lower
lower
lower
2nd floor wall
lower
up

Q: why are these not "S"s?

wall-hung

why groups of 4? assume = A-4?

I

H

abs. 3+4

abs 1+2

Nothing for 9201-2.

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
S9201-69	EC	746753.59	3985340.41	0	~~72~~ 61	293.15	1.5' ~~54~~	72	64267.5
S9201-70	EC	746763.41	3985324.26	0	~~72~~	293.15	~~54~~	72	64267.5
S9201-71	E	746773.81	3985396.96	0	~~72~~	293.15	54		31750
S9201-72	E	746783.63	3985380.81	0	~~72~~	293.15	54		31750
S9201-73	E	746793.46	3985364.66	0	~~72~~	293.15	54		31750
S9201-74	E	746803.27	3985348.52	0	~~72~~	293.15	54		31750

also 5+6

extra + recovery

SMFlack

Q.C. Observations

9201 ≡ A
9202 ≡ B

If anything, didn't include some sources.

no drawing of roof sources (A-4): 85% of roof (35% of total bldg) NOT included

→ (A-5): louvers were bigger (with no velocity).

no drawings of any sources.

Fan size assumption of proportionality to vol. flow rate not applied consistently.

misc. math errors on ht. of sources for A-4 and B-4.

drawings

math error on A-5
186200 ÷ 4 = 46550 cfm

~~(B-4)~~: do "V" sources go (up) or horiz? (they're shown on roof)

→ (A-2): nothing included in modeling - need to add 4.5 sources

(81-10): temp is wrong s/b 200°F
stack ht. is 16', not 19.3'

temps switched betw. 81-10 and 9401-1 and -2.

(stm. plants:)

9401-1, -2 / temp is wrong s/b 300°F

9401-3 / stack ht is 190', not 100'

Δ to 2 stacks
Δ diam's of both

Only 1955 modeled.

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General Questions

1. Why can't model X pounds from one source at center of roof?
   Some sources in wall, so up, N and S needed.
   Why can't model X pounds from 3 sources (up, N, S)?
   ? ~~diams~~ areas, volumes and velocities vary.
   ft. ft³/min ft/min

2. If not include all 30 sources, but only 10, of which the other 20 represent 35% of total bldg. ventln, is this a sig. error?
   Does the underrepresentation of the area of a source with NO velocity make a sig. difference? (i.e., louvers)

3. X lbs. released from a bldg. per yr. was calc'd using total exhaust cfm and avg bldg. air concs
   If all that exhaust cfm is not represented in the modeling, then would the off-site air concs ↑ or ↓? (not diluted as much →→ ↑)

~~3.b. How were the lbs of Hg released from a bldg. distributed to the various sources?~~

1.b. Would Hg from wall source emissions (~~with~~ with velocity) hit the ground sooner than roof emissions?

4. Some (Y-12 ventln. studies) measured Hg conc. at the exhaust points, multiplied by the cfm at that exhaust points, and calc'd lbs/d released. We multiplied bldg. avg. conc. by total bldg. cfm to calc. lbs/d.
   Exhaust pt concs were always .2-.3, ours were <.1

chk. Y/EX-21

cfm	Bldg		
2M	A-5	38 lb/d	(1956)
3.6M	A-4		(1953)
0.5-1M	B-4	8.6 lb/d	
48 K	A-2	1 lb/d	(1954)

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
S9201-41	187	747019.55	3985468.79	0	93		54	2201	35000
S9201-42	186	747009.73	3985484.94	0	93		54	2201	
S9201-43	185	746999.91	3985501.08	0	93		54	2201	
S9201-44	184	746990.09	3985517.23	0	93		54	2201	
S9201-45	183	746933.27	3985416.30	0	93		54	2201	
S9201-46	182	746923.45	3985432.45	0	93		54	2201	
S9201-47	181	746913.63	3985448.60	0	93		54	2201	
S9201-48	180	746903.81	3985464.74	0	93		54	2201	
S9201-51	179	746783.36	3985336.40	0	93		54		76000
S9201-52	178	746773.54	3985352.55	0	93		54		76000
S9201-53	177	746763.71	3985368.69	0	93		54		76000
S9201-54	176	746753.89	3985384.84	0	93		54		76000
S9201-55	175	746697.08	3985283.91	0	93		54		46200
S9201-56	174	746687.26	3985300.06	0	93		54		46200
S9201-57	173	746677.44	3985316.21	0	93		54		46200
S9201-58	171	746667.61	3985332.35	0	93		54		46200
S9401-11	146	748020.91	3986023.46	0	100		12.5FT		
S81-101	135	747175.14	3985329.55	0	5.88M		14		1300
S9401-21	134	747083.59	3985385.07	0	100		12.5FT		
S9401-31	133	746929.02	3985306.16	0	100		12.5FT		
S9401-32	132	746962.56	3985326.57	0	100		15FT		
S9204-41	8	746501.30	3985191.05	0	76		81	1667	60000
S9204-42	7	746524.04	3985204.88	0	76		81	1667	60000
F9201-41	124	746915.26	3985392.50	0					
F9201-431	123	746917.16	3985393.65	0	57		72	2483	70200
F9201-42	122	746919.06	3985394.81	0					
F9201-432	121	746920.96	3985395.96	0	57		72	2483	70200
F9201-43	120	746922.86	3985397.12	0					
F9201-44	119	746936.94	3985396.41	0	57		108	2248	143000
F9201-45	118	746943.10	3985400.16	0					
F9201-46	117	746949.25	3985403.90	0	57		108	2248	143000

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
F9201-47	116	746959.21	3985409.96	0	57		72	2483	70200
F9201-433	115	746961.12	3985411.12	0					
F9201-48	114	746963.02	3985412.27	0	57		72	2483	70200
F9201-434	113	746964.92	3985413.43	0	57		72	2483	70200
F9201-49	112	746966.82	3985414.59	0	57		72	2483	70200
F9201-410	111	747005.66	3985438.21	0	57		72	2483	70200
F9201-435	110	747007.56	3985439.37	0					
F9201-411	109	747009.46	3985440.52	0	57		72	2483	70200
F9201-436	108	747011.36	3985441.68	0	57		72	2483	70200
F9201-412	107	747013.26	3985442.84	0	57		72	2483	70200
F9201-413	106	747023.22	3985448.90	0	57		108	2248	143000
F9201-414	105	747029.38	3985452.64	0					
F9201-415	104	747035.53	3985456.39	0	57		108	2248	143000
F9201-416	103	747035.81	3985504.05	0	37		42	2339	22500
F9201-417	102	747033.50	3985507.85	0	37		42	2339	22500
F9201-418	101	747031.19	3985511.65	0	37		42	2339	22500
F9201-419	100	747028.87	3985515.45	0	37		42	2339	22500
F9201-420	99	747026.21	3985519.83	0	17		60	2292	45000
F9201-421	98	747023.90	3985523.64	0	17		60	2292	45000
F9201-422	97	747008.10	3985541.04	0					
F9201-437	96	747006.20	3985539.88	0	57		72	2483	70200
F9201-423	95	747004.30	3985538.72	0	57		72	2483	70200
F9201-438	94	747002.40	3985537.57	0	57		72	2483	70200
F9201-424	93	747000.50	3985536.41	0	57		72	2483	70200
F9201-425	92	746986.42	3985537.12	0	57		108	2248	143000
F9201-426	91	746980.26	3985533.38	0					
F9201-427	90	746974.11	3985529.63	0	57		108	2248	143000
F9201-428	89	746900.14	3985484.64	0	57		108	2248	143000
F9201-429	88	746893.98	3985480.89	0					
F9201-430	87	746887.83	3985477.14	0	57		108	2248	143000
F9201-51	70	746679.06	3985260.11	0					

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
F9201-531	69	746680.97	3985261.26	0					
F9201-52	68	746682.87	3985262.42	0					
F9201-532	67	746684.77	3985263.58	0					
F9201-53	66	746686.67	3985264.73	0					
F9201-54	65	746700.75	3985264.02	0	77	293.15	90		89500
F9201-55	64	746706.90	3985267.77	0					
F9201-56	63	746713.06	3985271.51	0	77	293.15	90		89500
F9201-57	62	746723.02	3985277.57	0					
F9201-533	61	746724.92	3985278.73	0					
F9201-58	60	746726.82	3985279.88	0					
F9201-534	59	746728.72	3985281.04	0					
F9201-59	58	746730.62	3985282.20	0					
F9201-510	57	746769.46	3985305.82	0					
F9201-535	56	746771.36	3985306.98	0					
F9201-511	55	746773.26	3985308.14	0					
F9201-536	54	746775.16	3985309.29	0					
F9201-512	53	746777.07	3985310.45	0					
F9201-513	52	746787.03	3985316.51	0	77	293.15	90		45300
F9201-514	51	746793.18	3985320.25	0					
F9201-515	50	746799.34	3985324.00	0	77	293.15	90		45300
F9201-516	49	746799.62	3985371.66	0					
F9201-517	48	746797.30	3985375.46	0					
F9201-518	46	746795.00	3985379.27	0					
F9201-519	45	746792.68	3985383.07	0					
F9201-520	44	746790.02	3985387.44	0					
F9201-521	43	746787.70	3985391.25	0					
F9201-522	42	746771.91	3985408.65	0					
F9201-537	41	746770.01	3985407.49	0					
F9201-523	40	746768.11	3985406.33	0					
F9201-538	39	746766.21	3985405.18	0					
F9201-524	38	746764.30	3985404.02	0					

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
F9201-525	37	746750.23	3985404.73	0	77	293.15	90		45300
F9201-526	36	746744.07	3985400.99	0					
F9201-527	35	746737.91	3985397.24	0	77	293.15	90		45300
F9201-528	34	746663.95	3985352.25	0	77	293.15	90		89500
F9201-529	33	746657.79	3985348.50	0	37	293.15	60	2037	40000
F9201-530	32	746651.63	3985344.75	0	77	293.15	90		89500
V9204-41	17	746541.31	3985232.83	0	71	293.15	36	2829	20000
V9204-42	16	746532.51	3985227.47	0	71	293.15	36	2829	20000
V9204-43	15	746523.29	3985221.87	0	71	293.15	36	3508	24800
V9204-44	14	746514.20	3985216.33	0	71	293.15	36	2829	20000
V9204-45	13	746504.99	3985210.73	0	71	293.15	36	3508	24800
V9204-46	12	746496.06	3985205.30	0	71	293.15	36	2829	20000
V9204-47	11	746486.85	3985199.69	0	71	293.15	36	3508	24800
V9204-48	10	746477.75	3985194.16	0	71	293.15	36	2829	20000
V9204-49	9	746468.54	3985188.56	0	71	293.15	36	2829	20000
F9204-41	6	746489.9	3985184.1	0	60.5	293.15	60	2037	40000
F9204-42	5	746512.7	3985198	0	60.5	293.15	60	2037	40000
F9204-43	4	746535.4	3985211.8	0	60.5	293.15	60	2037	40000
F9204-44	3	746519.9	3985237.3	0	60.5	293.15	60	2037	40000
F9204-45	2	746497.2	3985223.4	0	60.5	293.15	60	2037	40000
F9204-46	1	746474.4	3985209.6	0	60.5	293.15	60	2037	40000
S9201-59		746647.7	3985320.24	0	72	293.15	54		75355
S9201-60		746657.52	3985304.09	0	72	293.15	54		75355
S9201-61		746667.34	3985287.94	0	72	293.15	54		75355
S9201-62		746677.16	3985271.80	0	72	293.15	54		75355
S9201-63		746687.56	3985344.49	0	72	293.15	108		114223.13
S9201-64		746697.38	3985328.34	0	72	293.15	108		114223.13
S9201-65		746707.20	3985312.19	0	72	293.15	108		114223.13
S9201-66		746717.03	3985296.05	0	72	293.15	108		114223.13
S9201-67		746733.94	3985372.71	0	72	293.15	54		64267.5
S9201-68		746743.77	3985356.56	0	72	293.15	54		64267.5

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
S9201-69		746753.59	3985340.41	0	72	293.15	54		64267.5
S9201-70		746763.41	3985324.26	0	72	293.15	54		64267.5
S9201-71		746773.81	3985396.96	0	72	293.15	54		31750
S9201-72		746783.63	3985380.81	0	72	293.15	54		31750
S9201-73		746793.46	3985364.66	0	72	293.15	54		31750
S9201-74		746803.27	3985348.52	0	72	293.15	54		31750

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)	
S9201-4 1	187	747019.55	3985468.79	0	93'	293.15	54"	2201	35000	
S9201-4 2	186	747009.73	3985484.94	0						
S9201-4 3	185	746999.91	3985501.08							
S9201-4 4	184	746990.09	3985517.23							
S9201-4 5	183	746933.27	3985416.30							
S9201-4 6	182	746923.45	3985432.45							
S9201-4 7	181	746913.63	3985448.60							
S9201-4 8	180	746903.81	3985464.74							
S9201-5 1	179	746783.36	3985336.40		93'		[illegible]		76,000	
S9201-5 2	178	746773.54	3985352.55						76000	
S9201-5 3	177	746763.71	3985368.69						72000	
S9201-5 4	176	746753.89	3985384.84						76000	
S9201-5 5	175	746697.08	3985283.91				54"		46200	
S9201-5 6	174	746687.26	3985300.06						46200	
S9201-5 7	173	746677.44	3985316.21						46200	
S9201-5 8	171	746667.61	3985332.35			293.15			46200	
S9401-1 1	146	748020.91	3986023.46		100'	300°F	12.5'			
S81-10 1	135	747175.14	3985329.55	0	5.88m	200°F	14"		1300	
S9401-2 1	134	747083.59	3985385.07		100'	300°F	12.5'			
S9401-3 1	133	746929.02	3985306.16		100'	300°F	12.5'			
S9401-3 2	132	746962.56	3985326.57		100'	300°F	15'			
S9204-4 1	8	746501.30	3985191.05		76'	293.17	81"	1667	60000	
S9204-4 2	7	746524.04	3985204.88		76'	293.17	81"	1667	60000	
~~F9201-4 1~~	~~124~~	~~746915.26~~	~~3985392.50~~							H
~~F9201-4 3 1~~	~~123~~	~~746917.16~~	~~3985393.65~~		57'	293.15	72"	2483	70200	H
~~F9201-4 2~~	~~122~~	~~746919.06~~	~~3985394.81~~							
~~F9201-4 3 2~~	~~121~~	~~746920.96~~	~~3985395.96~~		57'	293.15	72"	2483	70200	H
~~F9201-4 3~~	~~120~~	~~746922.86~~	~~3985397.12~~							
F9201-4 4	119	746936.94	3985396.41		57'	293.15	108"	2248	143000	H
~~F9201-4 5~~	~~118~~	~~746943.10~~	~~3985400.16~~							
F9201-4 6	117	746949.25	3985403.90	0	57'	293.15	108"	2248	143000	H

SOURCES

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
F9201-4 7	116	746959.21	3985409.96		57'		72"	2483	70200
~~F9201-4 33~~	~~115~~	~~746961.12~~	~~3985411.12~~						
F9201-4 8	114	746963.02	3985412.27		57'		72"	2483	70200
F9201-4 31	113	746964.92	3985413.43		57'		72"	2483	70200
F9201-4 9	112	746966.82	3985414.59		57'		72"	2483	70200
F9201-4 10	111	747005.66	3985438.21		57'		72"	2483	70200
~~F9201-4 35~~	~~110~~	~~747007.56~~	~~3985439.37~~						
F9201-4 11	109	747009.46	3985440.52						
F9201-4 36	108	747011.36	3985441.68						
F9201-4 12	107	747013.26	3985442.84		57'		72"	2483	70200
F9201-4 13	106	747023.22	3985448.90		57'		108"	2248	143000
~~F9201-4 14~~	~~105~~	~~747029.38~~	~~3985452.64~~						
F9201-4 15	104	747035.53	3985456.39		57'		108"	2248	143000
F9201-4 16	103	747035.81	3985504.05		37'		42"	2339 fpm	22500
F9201-4 17	102	747033.50	3985507.85		37'		42"	2339 fpm	22500
F9201-4 18	101	747031.19	3985511.65		37'		42"	2339 fpm	22500
F9201-4 19	100	747028.87	3985515.45		37'		42"	2339 fpm	22500
F9201-4 20	99	747026.21	3985519.83	0	17'	293.15	60"	2292 fpm	45000
F9201-4 21	98	747023.90	3985523.64	0	17'		60"	2292 fpm	45000
~~F9201-4 22~~	~~97~~	~~747008.10~~	~~3985541.04~~						
F9201-4 37	96	747006.20	3985539.88		57'		72"	2483	~~8~~70200
F9201-4 23	95	747004.30	3985538.72						70200
F9201-4 38	94	747002.40	3985537.57						70200
F9201-4 24	93	747000.50	3985536.41		57'		72"	2483	70200
F9201-4 25	92x	746986.42	3985537.12		57'		108"	2248	143,000
~~F9201-4 26~~	~~91~~	~~746980.26~~	3985533.38						
F9201-4 27	90x	746974.11	3985529.63		57'		108"	2248	143,000
F9201-4 28	89	746900.14	3985484.64		57'		108	2248	143,000
~~F9201-4 29~~	~~88~~	~~746893.98~~	~~3985480.89~~						
F9201-4 30	87	746887.83	3985477.14		57'		108"	2248	143000
F9201-5 1	70	746679.06	3985260.11	0					

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
F9201-531	69	746680.97	3985261.26						
F9201-52	68	746682.87	3985262.42						
F9201-532	67	746684.77	3985263.58						
F9201-53	66	746686.67	3985264.73						
F9201-54	65	746700.75	3985264.02		77'	293.15	90'		85500
F9201-55	64	746706.90	3985267.77						
F9201-56	63	746713.06	3985271.51		77'	293.15	90'		85500
F9201-57	62	746723.02	3985277.57						
F9201-533	61	746724.92	3985278.73						
F9201-58	60	746726.82	3985279.88						
F9201-534	59	746728.72	3985281.04						
F9201-59	58	746730.62	3985282.20						
F9201-510	57	746769.46	3985305.82						
F9201-535	56	746771.36	3985306.98						
F9201-511	55	746773.26	3985308.14						
F9201-536	54	746775.16	3985309.29						
F9201-512	53	746777.07	3985310.45						
F9201-513	52	746787.03	3985316.51		77'	293.15	90'		45300
F9201-514	51	746793.18	3985320.25						
F9201-515	50	746799.34	3985324.00		77'	293.15	90'		45300
F9201-516	49	746799.62	3985371.66						
F9201-517	48	746797.30	3985375.46						
F9201-518	46	746795.00	3985379.27						
F9201-519	45	746792.68	3985383.07						
F9201-520	44	746790.02	3985387.44						
F9201-521	43	746787.70	3985391.25						
F9201-522	42	746771.91	3985408.65						
F9201-537	41	746770.01	3985407.49						
F9201-523	40	746768.11	3985406.33						
F9201-538	39	746766.21	3985405.18						
F9201-524	38	746764.30	3985404.02						

SOURCES

STACK I.D.		X-UTM (m)	Y-UTM (m)	SOURCE BASE ELEVATION	HEIGHT (m)	TEMPERATURE (K)	DIAMETER (m)	EXIT VELOCITY (m/s)	VOLUME FLOW RATE (cfm)
F9201-5 25	37	746750.23	3985404.73	0	77'	243.15	90"		45300
F9201-5 26	36	746744.07	3985400.99		77'		90"		45300
F9201-5 27	35	746737.91	3985397.24		77'		90"		89500
F9201-5 28	34	746663.95	3985352.25		37'	293.15	60"	2037 fpm	40000
F9201-5 29	33	746657.79	3985348.50		77'	293.15	90"		89500
F9201-5 30	32	746651.63	3985344.75						
V9204-4 1	17	746541.31	3985232.83		71'	293.15	36"	2829	20000
V9204-4 2	16	746532.51	3985227.47					2829	20000
V9204-4 3	15	746523.29	3985221.87					3508	24800
V9204-4 4	14	746514.20	3985216.33					2829	20000
V9204-4 5	13	746504.99	3985210.73					3508	24800
V9204-4 6	12	746496.06	3985205.30					2829	20000
V9204-4 7	11	746486.85	3985199.69					3508	24800
V9204-4 8	10	746477.75	3985194.16					2829	20000
V9204-4 9	9	746468.54	3985188.56					2829	20000
F9204-4 1	6	746489.9	3985184.1		60.5'	293.15	60"	2037	40,000
F9204-4 2	5	746512.7	3985198						
F9204-4 3	4	746535.4	3985211.8						
F9204-4 4	3	746519.9	3985237.3						
F9204-4 5	2	746497.2	3985223.4						
F9204-4 6	1	746474.4	3985209.6						

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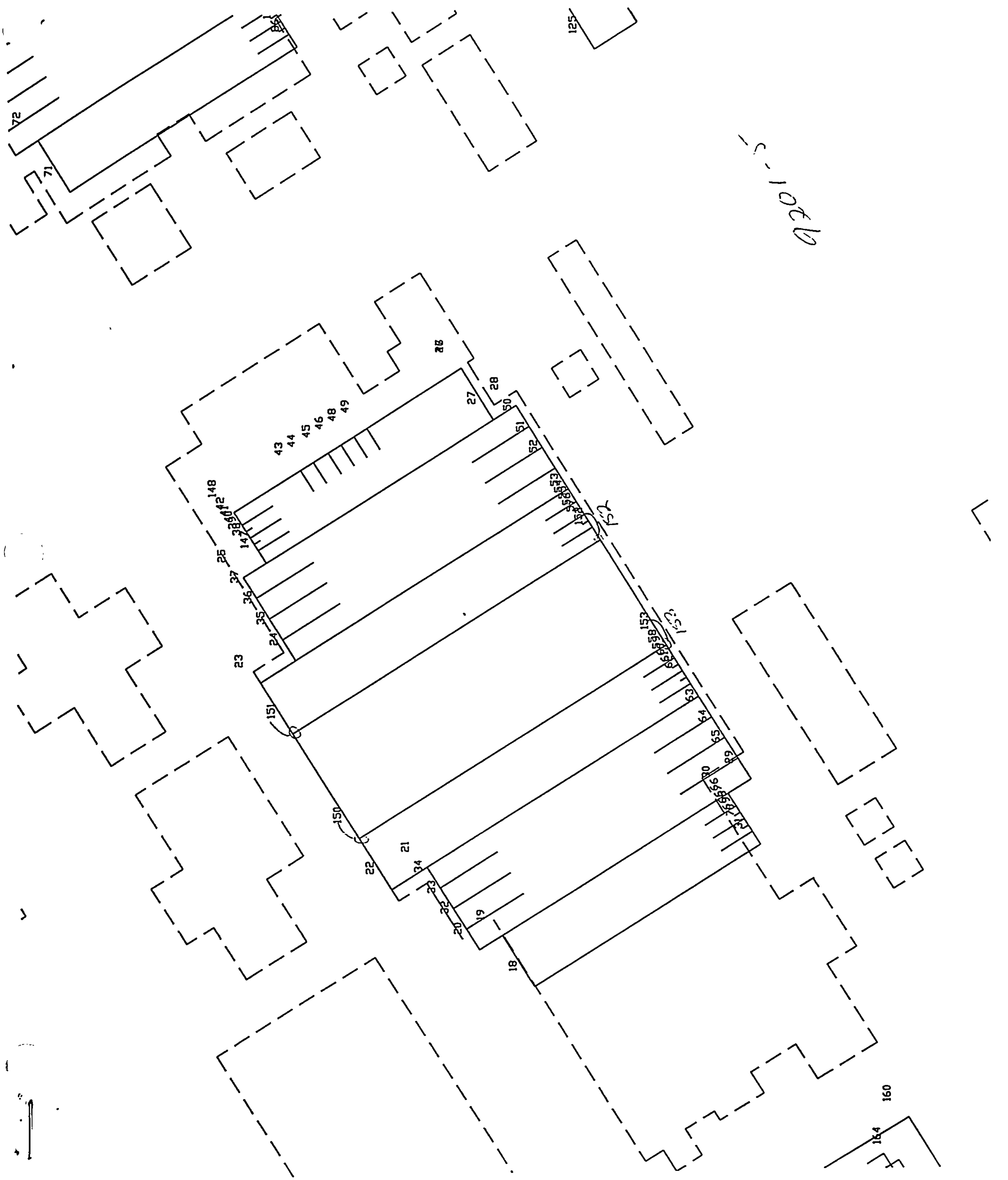
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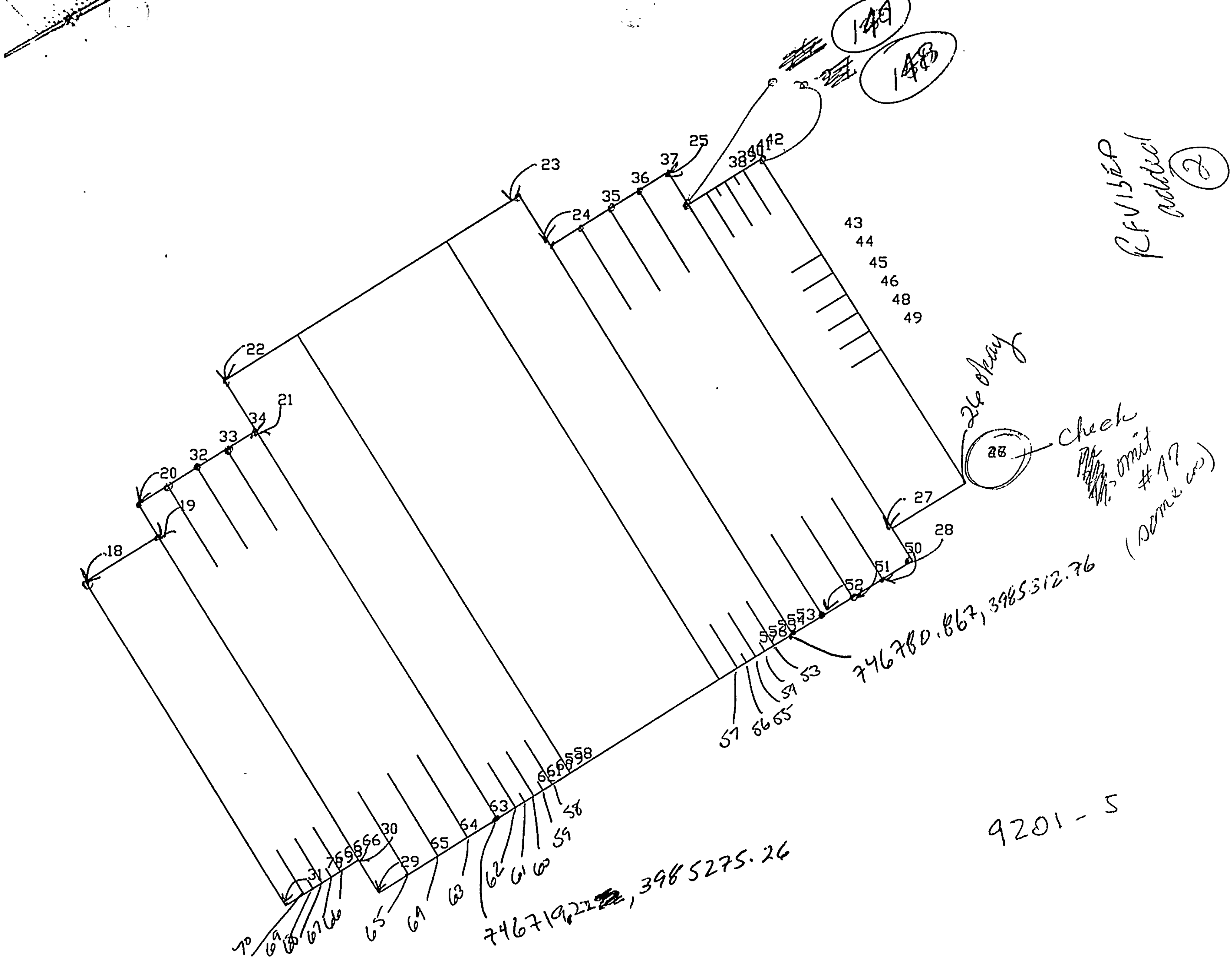

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746719.22, 3985275.26
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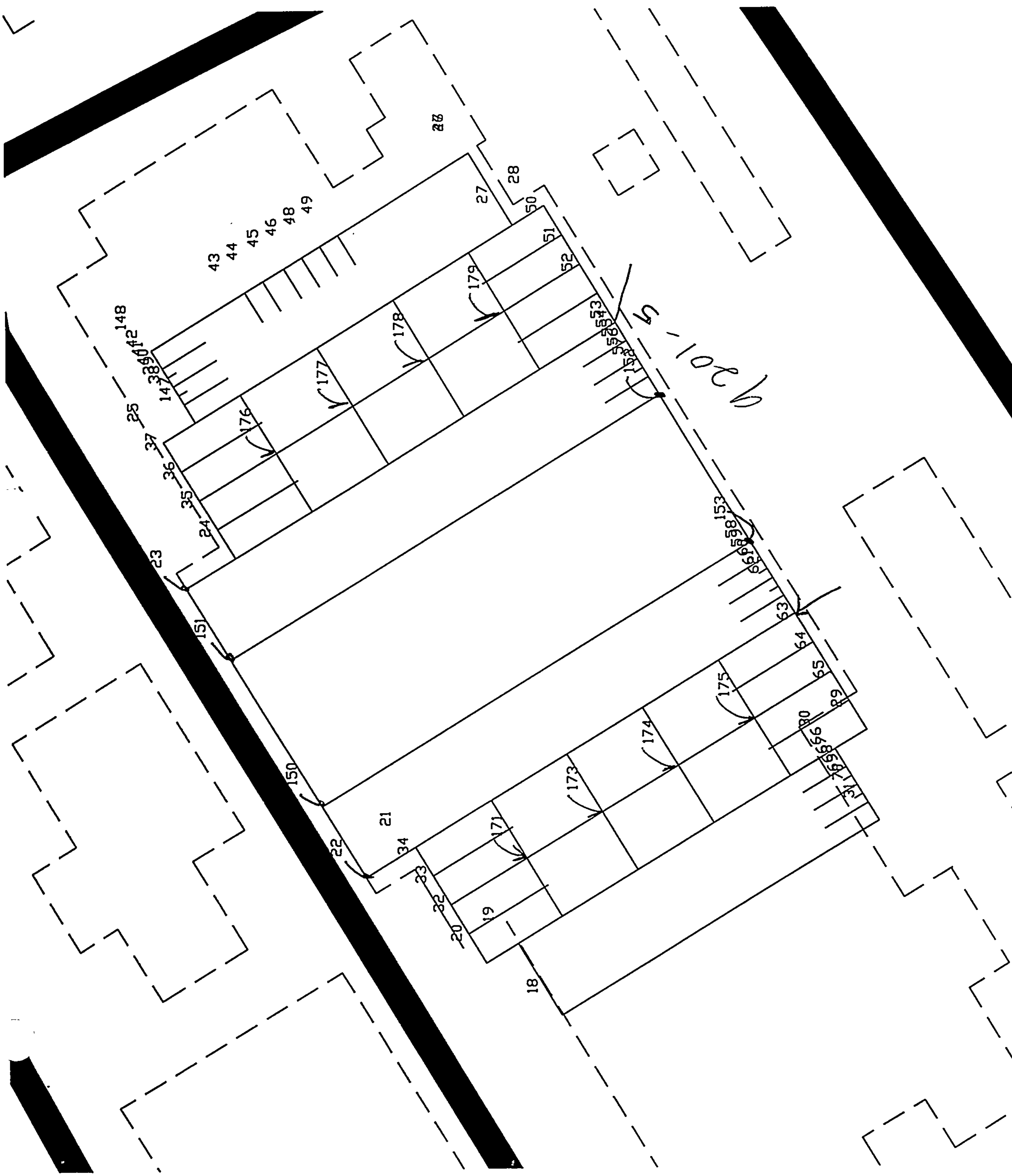

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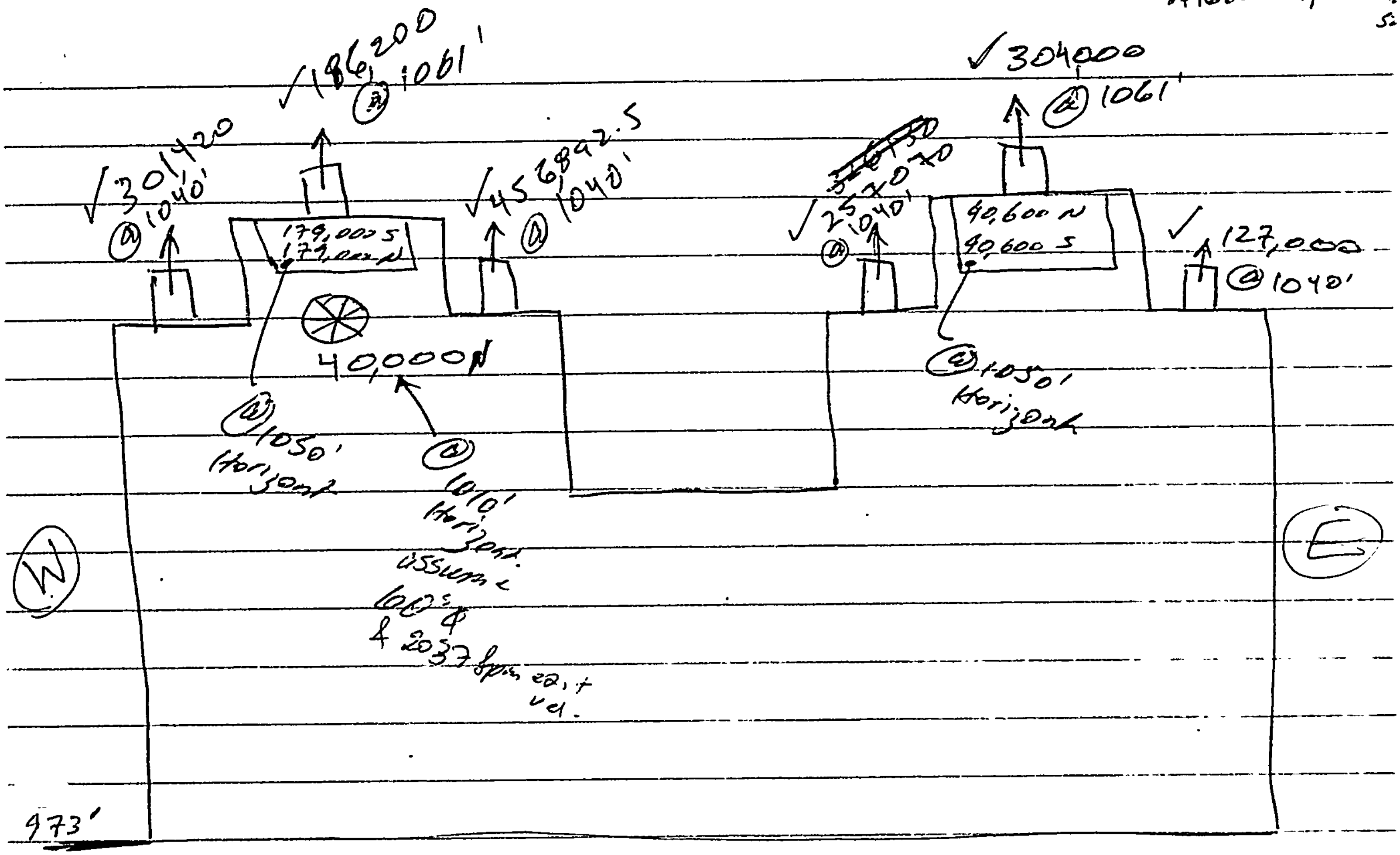

4201-5

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746677.16, 3985271.80

~~746733.44, 3985372.71~~

746743.77, 3985356.56

746753.59, 3985340.41

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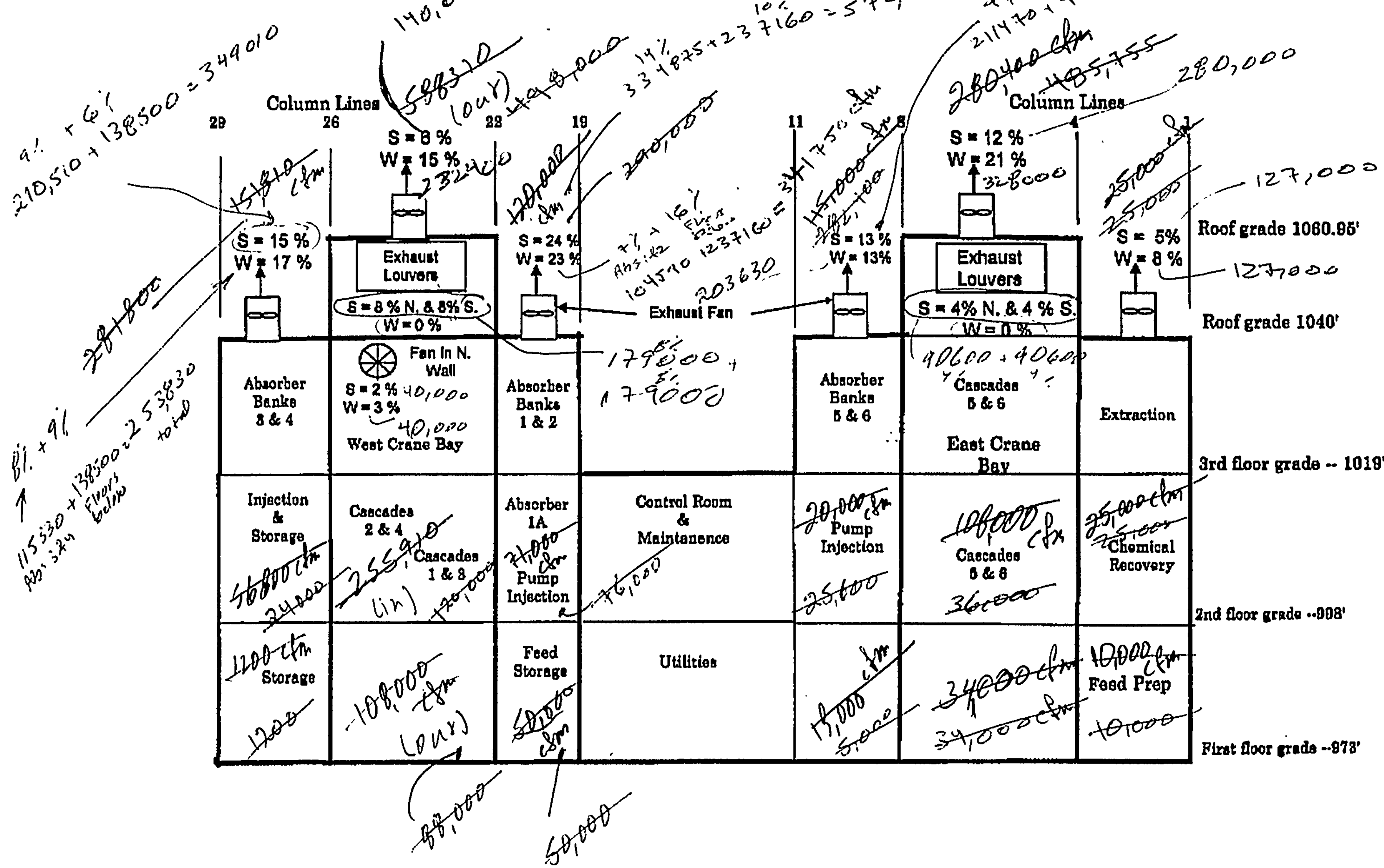
The highlighted information is the winter values (it is written in red ink on my sheet)

Bruce Simmon

Figure 2
Section A - A ---- Building 9201-5



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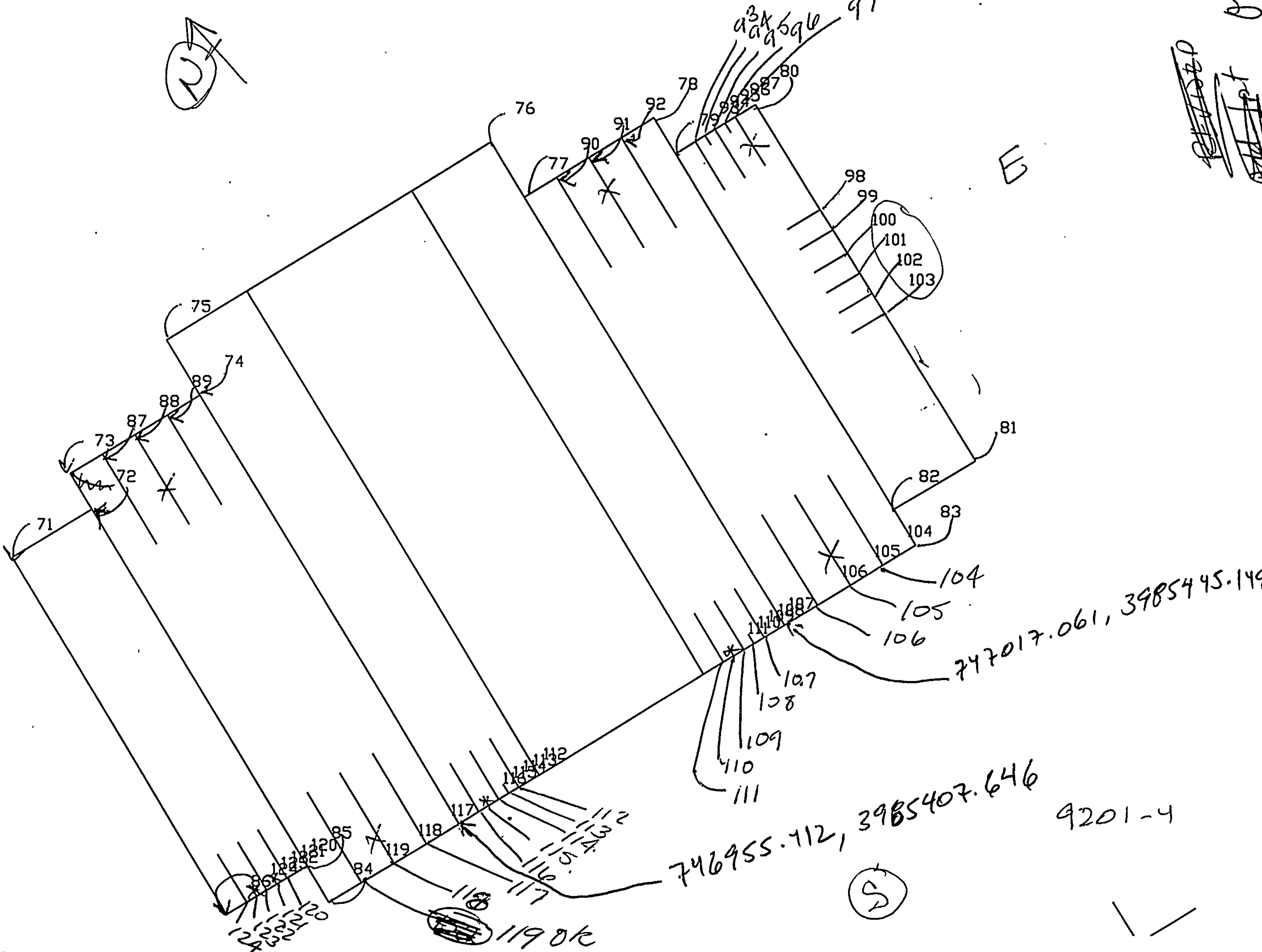

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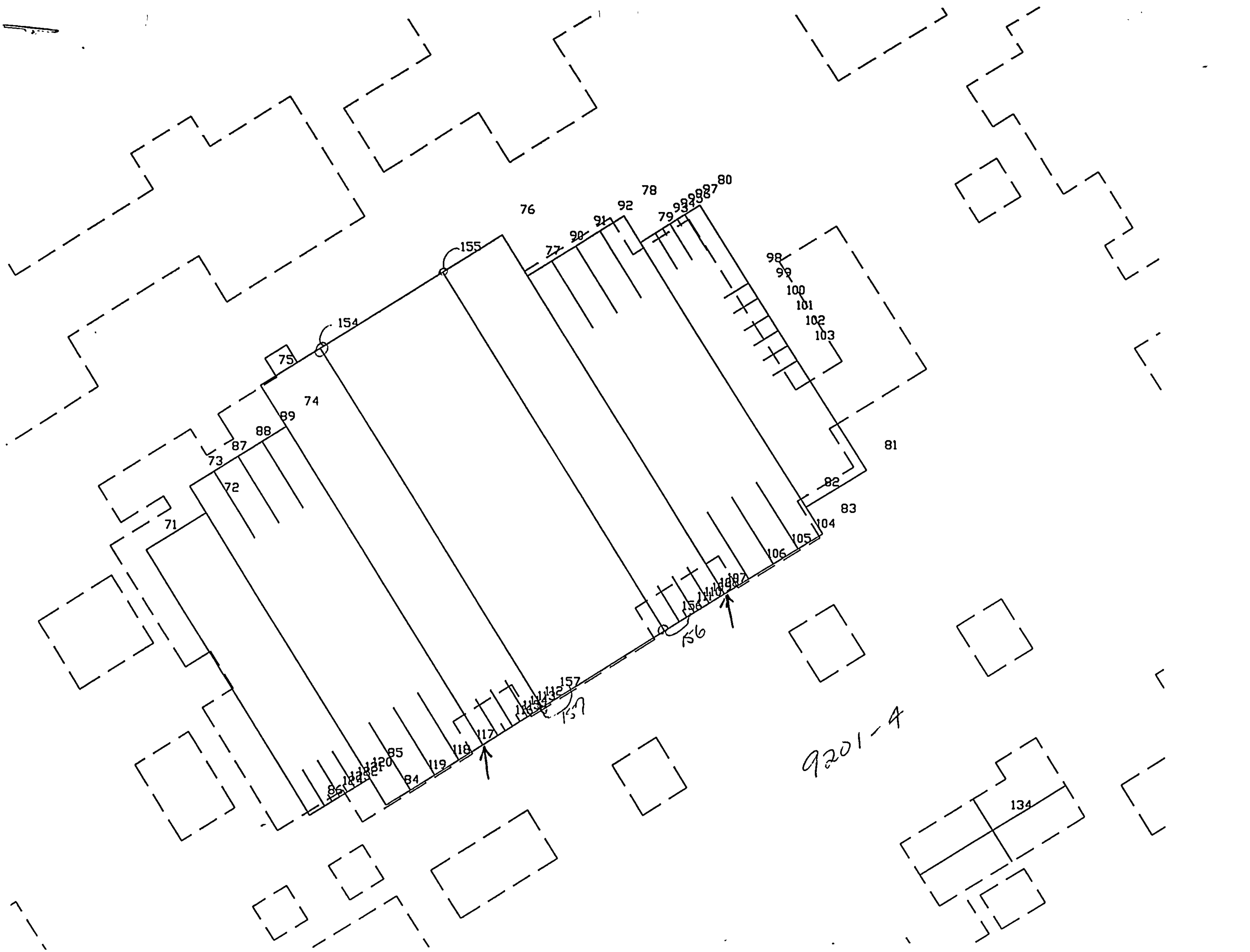
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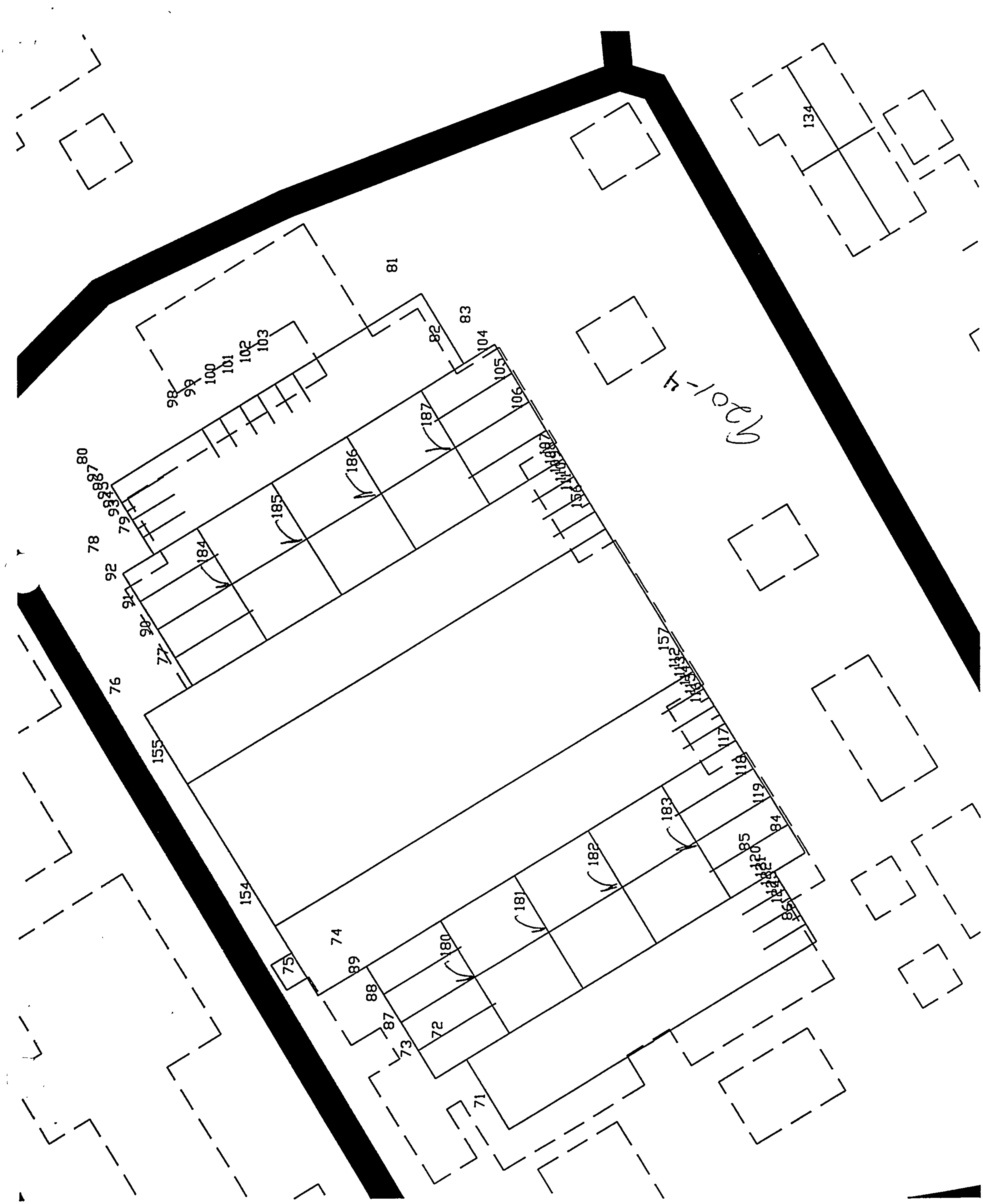

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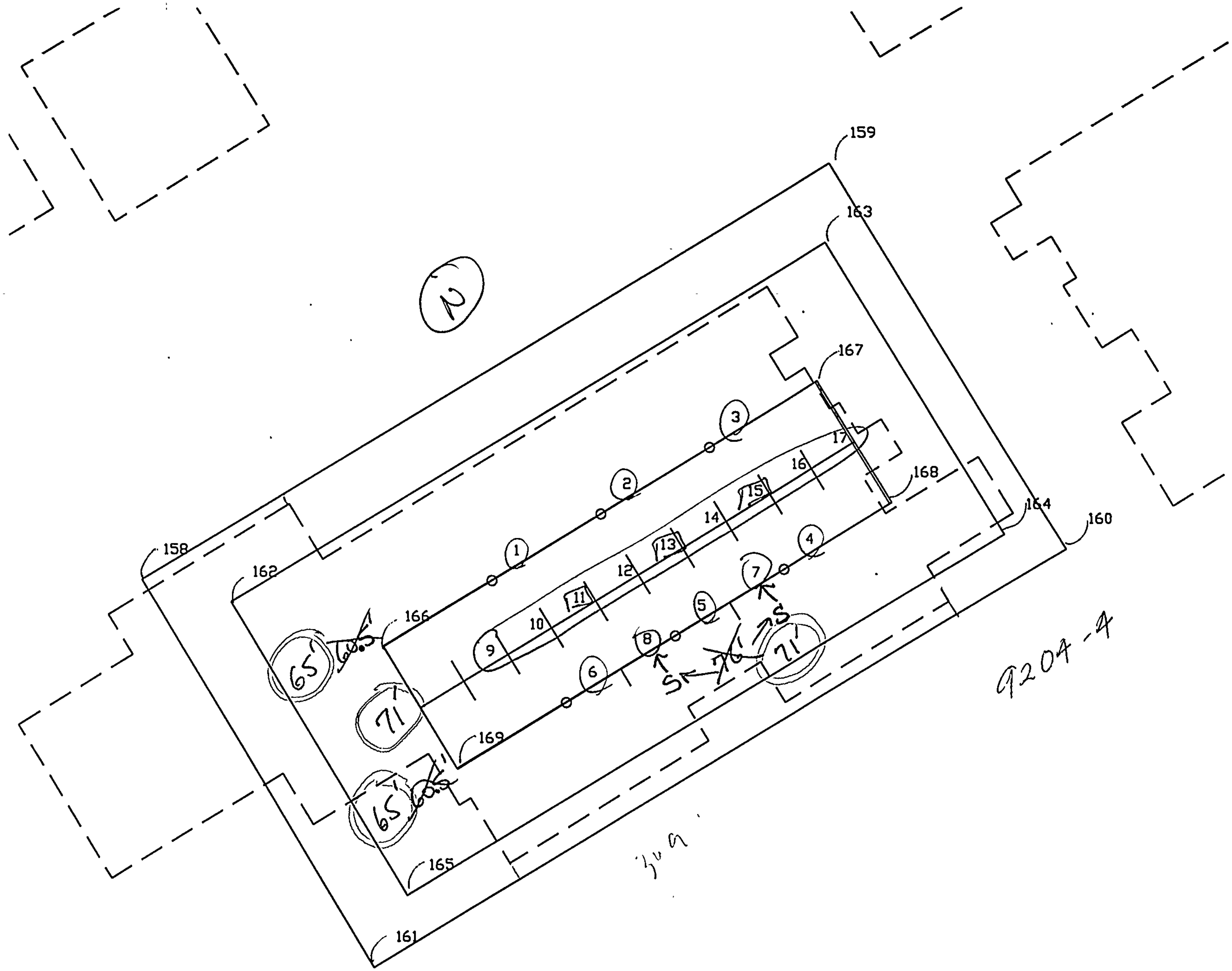

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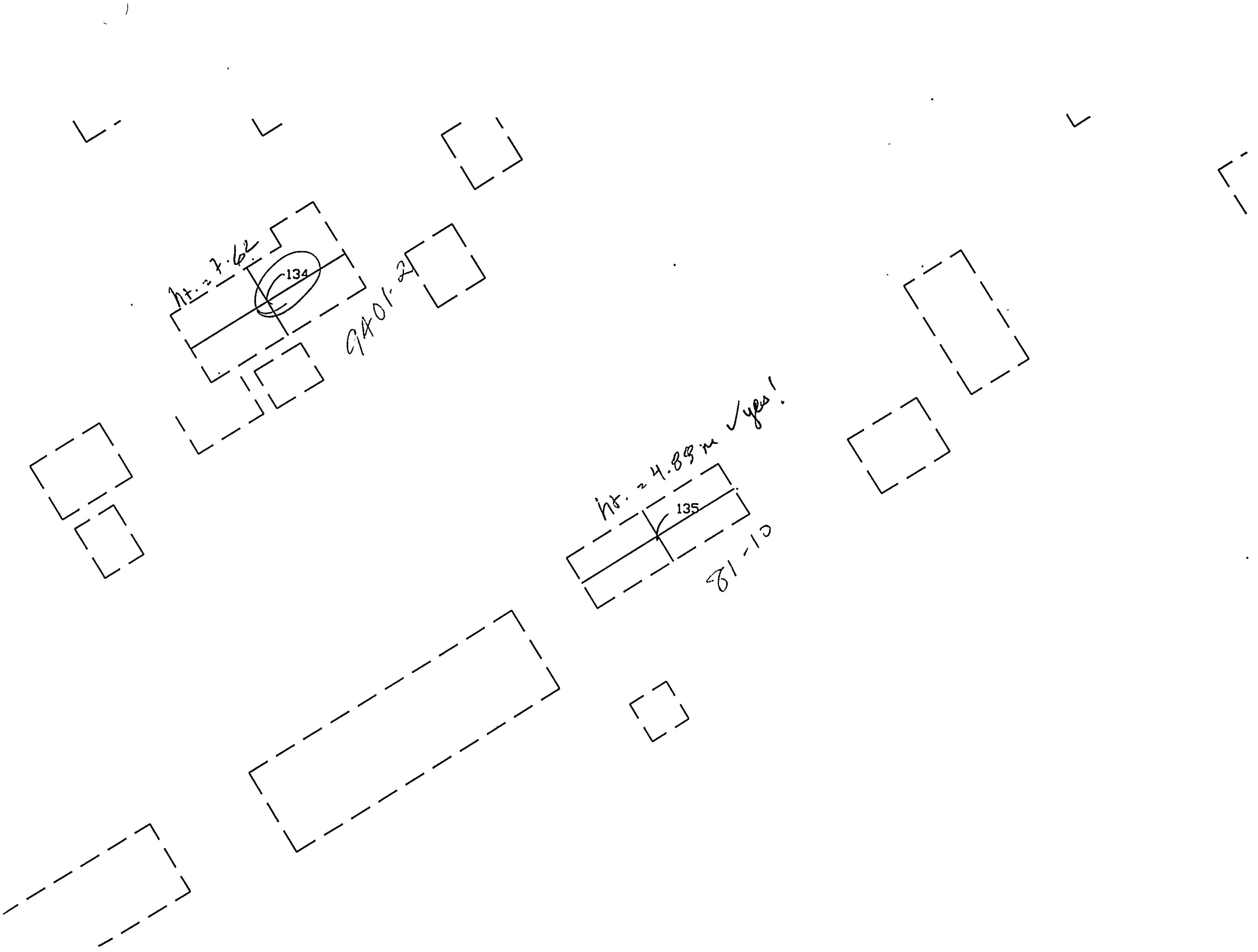
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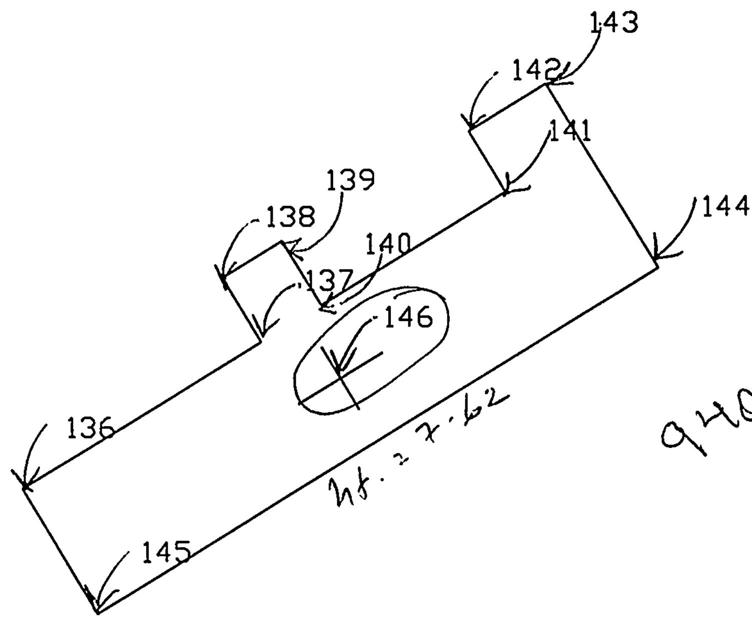

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STACK I.D.	VOLUME FLOW RATE	FRACTION OF MERCURY EMITTED FROM EACH SOURCE	MERCURY EMISSION	
	(cfm)	(unitless)	lb/yr	g/s
TOTAL MERCURY EMISSIONS FROM 9201-4 FOR THE YEAR 1955 (lb/yr)			9280.00	
S9201-41	35000	0.01353	125.56054	0.00181
S9201-42	35000	0.01353	125.56054	0.00181
S9201-43	35000	0.01353	125.56054	0.00181
S9201-44	35000	0.01353	125.56054	0.00181
S9201-45	35000	0.01353	125.56054	0.00181
S9201-46	35000	0.01353	125.56054	0.00181
S9201-47	35000	0.01353	125.56054	0.00181
S9201-48	35000	0.01353	125.56054	0.00181
F9201-44	143000	0.05528	513.00448	0.00738
F9201-46	143000	0.05528	513.00448	0.00738
F9201-47	70200	0.02714	251.83857	0.00362
F9201-48	70200	0.02714	251.83857	0.00362
F9201-49	70200	0.02714	251.83857	0.00362
F9201-410	70200	0.02714	251.83857	0.00362
F9201-411	70200	0.02714	251.83857	0.00362
F9201-412	70200	0.02714	251.83857	0.00362
F9201-413	143000	0.05528	513.00448	0.00738
F9201-415	143000	0.05528	513.00448	0.00738
F9201-416	22500	0.00870	80.71749	0.00116
F9201-417	22500	0.00870	80.71749	0.00116
F9201-418	22500	0.00870	80.71749	0.00116
F9201-419	22500	0.00870	80.71749	0.00116
F9201-420	45000	0.01740	161.43498	0.00232
F9201-421	45000	0.01740	161.43498	0.00232
F9201-423	70200	0.02714	251.83857	0.00362
F9201-424	70200	0.02714	251.83857	0.00362
F9201-425	143000	0.05528	513.00448	0.00738
F9201-427	143000	0.05528	513.00448	0.00738
F9201-428	143000	0.05528	513.00448	0.00738
F9201-430	143000	0.05528	513.00448	0.00738
F9201-431	70200	0.02714	251.83857	0.00362
F9201-432	70200	0.02714	251.83857	0.00362
F9201-434	70200	0.02714	251.83857	0.00362
F9201-436	70200	0.02714	251.83857	0.00362
F9201-437	70200	0.02714	251.83857	0.00362
F9201-438	70200	0.02714	251.83857	0.00362
TOTAL FLOW RATE (cfm)	2586800			
TOTAL MERCURY EMISSIONS FROM 9201-5 FOR THE YEAR 1955 (lb/yr)			9212.00	
S9201-51	76000	0.03438	316.73794	0.00456
S9201-52	76000	0.03438	316.73794	0.00456
S9201-53	76000	0.03438	316.73794	0.00456
S9201-54	76000	0.03438	316.73794	0.00456
S9201-55	46200	0.02090	192.54333	0.00277
S9201-56	46200	0.02090	192.54333	0.00277
S9201-57	46200	0.02090	192.54333	0.00277

STACK I.D.	VOLUME FLOW RATE	FRACTION OF MERCURY EMITTED FROM EACH SOURCE	MERCURY EMISSION	
	(cfm)	(unitless)	lb/yr	g/s
S9201-559	75355	0.03409	314.04983	0.00452
S9201-560	75355	0.03409	314.04983	0.00452
S9201-561	75355	0.03409	314.04983	0.00452
S9201-562	75355	0.03409	314.04983	0.00452
S9201-563	114223.13	0.05168	476.03682	0.00685
S9201-564	114223.13	0.05168	476.03682	0.00685
S9201-565	114223.13	0.05168	476.03682	0.00685
S9201-566	114223.13	0.05168	476.03682	0.00685
S9201-567	64267.5	0.02908	267.84152	0.00385
S9201-568	64267.5	0.02908	267.84152	0.00385
S9201-569	64267.5	0.02908	267.84152	0.00385
S9201-570	64267.5	0.02908	267.84152	0.00385
S9201-571	31750	0.01436	132.32144	0.00190
S9201-572	31750	0.01436	132.32144	0.00190
S9201-573	31750	0.01436	132.32144	0.00190
S9201-574	31750	0.01436	132.32144	0.00190
S9201-58	46200	0.02090	192.54333	0.00277
F9201-54	89500	0.04049	373.00060	0.00536
F9201-56	89500	0.04049	373.00060	0.00536
F9201-513	45300	0.02049	188.79248	0.00272
F9201-515	45300	0.02049	188.79248	0.00272
F9201-525	45300	0.02049	188.79248	0.00272
F9201-527	45300	0.02049	188.79248	0.00272
F9201-528	89500	0.04049	373.00060	0.00536
F9201-529	40000	0.01810	166.70418	0.00240
F9201-530	89500	0.04049	373.00060	0.00536
TOTAL FLOW RATE (cfm)	**2210382.52**			
TOTAL MERCURY EMISSIONS FROM STEAM PLANTS 1 & 2 FOR THE YEAR 1955 (lb/yr)				77
S9401-11 (Steam Plant 1)*		NA	38.5	0.00055
S9401-21 (Steam Plant 2)*		NA	38.5	0.00055
* The emissions for the steam plant are assumed to be equal for steam plant 1 & 2				
TOTAL MERCURY EMISSION FROM 81-10 FOR THE YEAR 1955 (lb/yr)			**0.00**	
S81-101	1300	NA	0.00	0.00
TOTAL MERCURY EMISSIONS FROM STEAM PLANT 3 FOR THE YEAR 1955 (lb/yr)				**0.00**
S9401-31		NA	0.00	0.00
S9401-32		NA	0.00	0.00
TOTAL MERCURY EMISSION FROM 9204-4 FOR THE YEAR 1955 (lb/yr)			**2767.00**	
S9204-41	60000	0.10823	299.45887	0.00431
S9204-42	60000	0.10823	299.45887	0.00431

STACK I.D.	VOLUME FLOW RATE	FRACTION OF MERCURY EMITTED FROM EACH SOURCE	MERCURY EMISSION	
	(cfm)	(unitless)	lb/yr	g/s
V9204-41	20000	0.03608	99.81962	0.00144
V9204-42	20000	0.03608	99.81962	0.00144
V9204-43	24800	0.04473	123.77633	0.00178
V9204-44	20000	0.03608	99.81962	0.00144
V9204-45	24800	0.04473	123.77633	0.00178
V9204-46	20000	0.03608	99.81962	0.00144
V9204-47	24800	0.04473	123.77633	0.00178
V9204-48	20000	0.03608	99.81962	0.00144
V9204-49	20000	0.03608	99.81962	0.00144
F9204-41	40000	0.07215	199.63925	0.00287
F9204-42	40000	0.07215	199.63925	0.00287
F9204-43	40000	0.07215	199.63925	0.00287
F9204-44	40000	0.07215	199.63925	0.00287
F9204-45	40000	0.07215	199.63925	0.00287
F9204-46	40000	0.07215	199.63925	0.00287
TOTAL FLOW RATE (cfm)	**554400**			
Notes:				
(1)	Volume Flow Rates are based on information provided by Earnie Choats and on engineering			
	judgement based on similarity of operations and fan sizes.			
(2)	Frcation of Mercury Emitted = Volume flow rate / Total volume flow rate			
(3)	Mercury Emission = Fraction of mercury emitted * Total mercury emissions			

STACK I.D.	VOLUME FLOW RATE	FRACTION OF MERCURY EMITTED FROM EACH SOURCE	MERCURY EMISSION	
	(cfm)	(unitless)	lb/yr	g/s
TOTAL MERCURY EMISSIONS FROM 9201-4 FOR THE YEAR 1955 (lb/yr)			9280.00	
S9201-41	35000	0.01353	125.56054	0.00181
S9201-42	35000	0.01353	125.56054	0.00181
S9201-43	35000	0.01353	125.56054	0.00181
S9201-44	35000	0.01353	125.56054	0.00181
S9201-45	35000	0.01353	125.56054	0.00181
S9201-46	35000	0.01353	125.56054	0.00181
S9201-47	35000	0.01353	125.56054	0.00181
S9201-48	35000	0.01353	125.56054	0.00181
F9201-44	143000	0.05528	513.00448	0.00738
F9201-46	143000	0.05528	513.00448	0.00738
F9201-47	70200	0.02714	251.83857	0.00362
F9201-48	70200	0.02714	251.83857	0.00362
F9201-49	70200	0.02714	251.83857	0.00362
F9201-410	70200	0.02714	251.83857	0.00362
F9201-411	70200	0.02714	251.83857	0.00362
F9201-412	70200	0.02714	251.83857	0.00362
F9201-413	143000	0.05528	513.00448	0.00738
F9201-415	143000	0.05528	513.00448	0.00738
F9201-416	22500	0.00870	80.71749	0.00116
F9201-417	22500	0.00870	80.71749	0.00116
F9201-418	22500	0.00870	80.71749	0.00116
F9201-419	22500	0.00870	80.71749	0.00116
F9201-420	45000	0.01740	161.43498	0.00232
F9201-421	45000	0.01740	161.43498	0.00232
F9201-423	70200	0.02714	251.83857	0.00362
F9201-424	70200	0.02714	251.83857	0.00362
F9201-425	143000	0.05528	513.00448	0.00738
F9201-427	143000	0.05528	513.00448	0.00738
F9201-428	143000	0.05528	513.00448	0.00738
F9201-430	143000	0.05528	513.00448	0.00738
F9201-431	70200	0.02714	251.83857	0.00362
F9201-432	70200	0.02714	251.83857	0.00362
F9201-434	70200	0.02714	251.83857	0.00362
F9201-436	70200	0.02714	251.83857	0.00362
F9201-437	70200	0.02714	251.83857	0.00362
F9201-438	70200	0.02714	251.83857	0.00362
TOTAL FLOW RATE (cfm)	2586800			
TOTAL MERCURY EMISSIONS FROM 9201-5 FOR THE YEAR 1955 (lb/yr)			9212.00	
S9201-51	76000	0.03438	316.73794	0.00456
S9201-52	76000	0.03438	316.73794	0.00456
S9201-53	76000	0.03438	316.73794	0.00456
S9201-54	76000	0.03438	316.73794	0.00456
S9201-55	46200	0.02090	192.54333	0.00277
S9201-56	46200	0.02090	192.54333	0.00277
S9201-57	46200	0.02090	192.54333	0.00277

STACK I.D.	VOLUME FLOW RATE	FRACTION OF MERCURY EMITTED FROM EACH SOURCE	MERCURY EMISSION	
	(cfm)	(unitless)	lb/yr	g/s
S9201-559	75355	0.03409	314.04983	0.00452
S9201-560	75355	0.03409	314.04983	0.00452
S9201-561	75355	0.03409	314.04983	0.00452
S9201-562	75355	0.03409	314.04983	0.00452
S9201-563	114223.13	0.05168	476.03682	0.00685
S9201-564	114223.13	0.05168	476.03682	0.00685
S9201-565	114223.13	0.05168	476.03682	0.00685
S9201-566	114223.13	0.05168	476.03682	0.00685
S9201-567	64267.5	0.02908	267.84152	0.00385
S9201-568	64267.5	0.02908	267.84152	0.00385
S9201-569	64267.5	0.02908	267.84152	0.00385
S9201-570	64267.5	0.02908	267.84152	0.00385
S9201-571	31750	0.01436	132.32144	0.00190
S9201-572	31750	0.01436	132.32144	0.00190
S9201-573	31750	0.01436	132.32144	0.00190
S9201-574	31750	0.01436	132.32144	0.00190
S9201-58	46200	0.02090	192.54333	0.00277
F9201-54	89500	0.04049	373.00060	0.00536
F9201-56	89500	0.04049	373.00060	0.00536
F9201-513	45300	0.02049	188.79248	0.00272
F9201-515	45300	0.02049	188.79248	0.00272
F9201-525	45300	0.02049	188.79248	0.00272
F9201-527	45300	0.02049	188.79248	0.00272
F9201-528	89500	0.04049	373.00060	0.00536
F9201-529	40000	0.01810	166.70418	0.00240
F9201-530	89500	0.04049	373.00060	0.00536
TOTAL FLOW RATE (cfm)	**2210382.52**			
TOTAL MERCURY EMISSIONS FROM STEAM PLANTS 1 & 2 FOR THE YEAR 1955 (lb/yr)				77
S9401-11 (Steam Plant 1)*		NA	38.5	0.00055
S9401-21 (Steam Plant 2)*		NA	38.5	0.00055
* The emissions for the steam plant are assumed to be equal for steam plant 1 & 2				
TOTAL MERCURY EMISSION FROM 81-10 FOR THE YEAR 1955 (lb/yr)			**0.00**	
S81-101	1300	NA	0.00	0.00
TOTAL MERCURY EMISSIONS FROM STEAM PLANT 3 FOR THE YEAR 1955 (lb/yr)				**0.00**
S9401-31		NA	0.00	0.00
S9401-32		NA	0.00	0.00
TOTAL MERCURY EMISSION FROM 9204-4 FOR THE YEAR 1955 (lb/yr)			**2767.00**	
S9204-41	60000	0.10823	299.45887	0.00431
S9204-42	60000	0.10823	299.45887	0.00431

STACK I.D.	VOLUME FLOW RATE	FRACTION OF MERCURY EMITTED FROM EACH SOURCE	MERCURY EMISSION	
	(cfm)	(unitless)	lb/yr	g/s
V9204-41	20000	0.03608	99.81962	0.00144
V9204-42	20000	0.03608	99.81962	0.00144
V9204-43	24800	0.04473	123.77633	0.00178
V9204-44	20000	0.03608	99.81962	0.00144
V9204-45	24800	0.04473	123.77633	0.00178
V9204-46	20000	0.03608	99.81962	0.00144
V9204-47	24800	0.04473	123.77633	0.00178
V9204-48	20000	0.03608	99.81962	0.00144
V9204-49	20000	0.03608	99.81962	0.00144
F9204-41	40000	0.07215	199.63925	0.00287
F9204-42	40000	0.07215	199.63925	0.00287
F9204-43	40000	0.07215	199.63925	0.00287
F9204-44	40000	0.07215	199.63925	0.00287
F9204-45	40000	0.07215	199.63925	0.00287
F9204-46	40000	0.07215	199.63925	0.00287
TOTAL FLOW RATE (cfm)	**554400**			

Notes:

(1) Volume Flow Rates are based on information provided by Earnie Choats and on engineering judgement based on similarity of operations and fan sizes.

(2) Frcation of Mercury Emitted = Volume flow rate / Total volume flow rate

(3) Mercury Emission = Fraction of mercury emitted * Total mercury emissions